ENGINEERING NEWS

MAYOR HEWITT, in accordance with the late bill abolishing the old Aqueduct Commission and directing him to select four members of the new Commission, on Aug. 1, announced the names of Gen. JAMES C. DUANE, JOHN G. TUCKER, FRANCIS M. SCOTT and WALTER HOWE as the members selected. Gen. DUANE is the lately retired Chief of Engineers, U. S. A.; Mr. TUCKER is a well known builder; Mr. SCOTT comes from the office of the Corporation Counsel and has had charge there of contract questions, and Mr. HOWE is a lawyer and ex Assemblyman.

THE Westinghouse Electric Light Co., of Pittsburg, Pa., the United States Electric Light Co., of New York, and the Consolidated Electric Light Co., are said to be contesting Edison's electric light patents in Canada, and are supporting applications to the Commissioner of Patents to annul patents for non-compliance with provisions of the Patent Act. Applications will probably be heard in September.

THE Carbon Iron Co., of Pittsburg, Pa., will begin on Aug. 15 to roll open hearth steel (new process or sponge steel fully described in previous issues of this journal) with universal edge up to 24-in. wide plates, and lengths up to 80 ft. and to usual thicknesses from ⅝-in. upwards. Engineers can now design long and wide members in one piece without increase in cost for material. Preparations are being made by this company to soon roll 80 ft. plates 36 ins. wide.

THE New England route via Staten Island is again being mildly agitated. The lately opened bridge over the Kill von Kull gives railway communication with Staten Island and now, according to ERASTUS WIMAN and his friends, a bridge over the Harlem to Ward's Island, and another from Ward's over Hell-Gate would give access to Long Island and the east side of the Narrows. A tunnel under, or a bridge over, the latter channel would complete the chain and enable Western goods and traffic to pass on to New England without even a stop-over at New York. The prospect for Staten Island is about as magnificent in its proportions as the general scheme. But we will wait yet awhile.

IT is reported that the Westinghouse Brake Co. has practically absorbed the American Brake Co., of St. Louis. The capital of the latter company was $2,000,000; it held patents for a steam driving wheel brake for locomotives, and for an improvement on the air brake.

The new ceiling for the Capitol at Albany is to be flat, for acoustic reasons, and to weigh only 400 tons instead of 3,200 tons of carved stone arch now being removed. The new ceiling will have iron ribs filled in with oak or papier-maché panels. The total cost of the improvement will be $270,000, including in this, however, other changes and improvements outside of the Assembly Chambers; the iron ceiling itself will only cost $80,000, instead of $400,000, the cost of the one now to be removed for reasons of safety.

CABLE communication between New York and Hayti *via* Santiago de Cuba, was opened July 26. The rate per word to Mole St. Nicholas, Hayti, is 56 cents, and to San Domingo, $1.06.

THE Edison machine shops, containing very valuable machinery and apparatus, were destroyed by fire July 28. The estimated loss is $32,000.

THE most serious railway accident of the week was the explosion of the boiler of a passenger locomotive, on July 31, at the Columbia Ave. Station, Philadelphia, of the Philadelphia & Reading Railroad. The engine was badly wrecked, and the burning fuel thrown from the fire box set fire to the depot, but the fire was soon put out. The engineer and fireman were both killed, and several persons more or less injured by falling pieces of the wreck. ——A similar accident occurred the same day on the Delaware, Lackawanna & Western Railroad near Clark's Summit, 7 miles north of Scranton, Pa. The engine was hauling a coal train. The engineer and fireman were killed.

THE following bridge accidents are reported: On July 25, a wooden highway bridge across the Patapsco river, near Sykesville, Md., gave way under a wagon and team.——On July 26, a canal bridge near Newark, O., gave way under a wagon and team, and one man was seriously injured.——On July 27 an iron railway bridge near Emaus, Pa., was badly damaged by an ore train which was derailed on the bridge by a cow.——On July 28 the bridge over a creek near Toms river, N. J., on the Philadelphia & Long Branch Railroad was damaged by fire.

DURING the week washouts have occurred on the Union Pacific, near Central City, Col., and also on the Southern Pacific and Sonora railroads in Arizona. Heavy rains have occurred in Florida.—— Another break in the Erie canal occurred near Rochester, N. Y., July 27.

A SINGULAR accident occurred July 14 on the Manchester, Sheffield & Lincolnshire Railway, near Hyde, England. An axle of a passenger car broke, and although the wheels kept the track the body of the car heeled over to such an extent that it was struck by a fast freight train and the side torn away. Four persons were killed and several injured. The car couplings and brake-pipe were not broken. According to report: "the axle was as clearly fractured as if it had been cut, but there appears to have been no flaw in it." The car had five compartments, and, we presume, had but two axles, as is usual in England for such short cars; with such an arrangement, any accident to wheels or axles is almost certain to cause serious results.

AN opportunity to compare the shipping of the United States with that of Great Britain and other countries is given by the statistics furnished by the British Board of Trade for 1887.

In 1860 the United States had registered for foreign trade 2,500,000 tons, while the United Kingdom had only 4,500,000 tons. Last year the United States had about 1,000,000 tons, and the United Kingdom had 7,250,000, while the British Empire, including the United Kingdom, had over 9,000,000 tons. The United States has, of course, a large fleet of lake and river steamers, the tonnage amounting to 3,000,000. The continental countries have not varied much for some years past. Norway stands at the head of the list, with 1,500,000 tons, Germany next, with 1,250,000, and France with 1,000,000. The remarkable change in American shipping since 1860 is even more forcibly shown by the following table of the tonnages entered and cleared in the United Kingdom in the trade with the United States for a few selected years.

	British, tons.	United States, tons.	Other countries, tons.	Totals, tons.
1853	857,250	1,592,939	91,199	2,541,388
1860	945,668	2,245,234	165,712	3,356,614
1865	1,231,660	484,008	152,692	1,868,450
1870	2,625,991	826,692	287,282	3,739,965
1880	6,939,245	612,634	1,441,952	8,993,831
1887	7,369,726	253,762	581,811	8,205,299

With respect to shipbuilding the United Kingdom built last year 377,000 tons, of which 70,000 tons were for foreigners. The United States built 150,000 tons, and sold 22,600 tons to foreigners.

BUFFALO bids fair to become a very important transhipping point for iron ore, and the facilities for unloading and shipping are being largely increased.

Leases have been secured for a term of years of a strip having 1,400 ft. frontage on the canal, and a depth of 200 ft. This will give room for the storage of 100,000 tons of ore. The contracts call for the completion of 400 ft. of dockage, with hoisting apparatus, railway tracks, and switches by Aug. 9. The other 1,000 ft. of dock will be pushed rapidly. Four Brown hoists, which will have the capacity of 1,000 tons of ore a day, will first be erected. Later two others will be added, giving the dock facilities for the unloading of 1,500 tons daily. By means of the Buffalo Creek Railroad connection may be made with all the railways running east. The new dock will thus have easy and convenient access to all ore consuming points.

"THE Argentine Railway Syndicate" is the ambitious title of a new English company just floated on the modest capital of $15,000. It proposes "to make preliminary, experimental or final surveys and prospecting of any tract of country in the Argentine Republic, with a view to the making of railways, tramways, roads, canals or other public works; and to explore and search for minerals, and generally to carry on business as railway and mining engineers and surveyors in any part of the world." This is a somewhat novel departure in the profession.

THE Italian Chamber of Deputies passed a bill within the last few weeks authorizing the construction of 1,870 miles of railway, mainly in South Italy which has few lines of iron-way. Twenty years ago one of the most sleepy and non-progressive of nations, Italy is now pushing ahead at a pace that makes all outsiders wonder where the revenue comes from to support her enormous army of idlers, and have yet enough left to build or at least project great public works.

THE island of Trinidad, British West Indies, has 54¼ miles of railway, all belonging to the Government. The line from Port of Spain to Armia extends about ten miles in an easterly direction; the line from Port of Spain to San Fernando, about 31 miles in a southerly direction, and the one from San Fernando to Princeton about 7 miles in an easterly direction. The various lines have been opened between 1876 and 1886. The roads extend through fertile plains, and along the sugar and cocoa plantations. The Government claims the right of way, but pays an average compensation for private property of about $100 per acre. The materials for construction were mostly imported from England. Telegraph and telephone communication is established along the lines.

IMMIGRATION continues unchecked. The figures for corresponding periods in 1887 and 1888, which we herewith submit, show a steady increase in the number of immigrants arriving in this country.

	1887	1888	Increase
Month ending June 30.	65,384	68,475	3,091
Six months ending June 30.	286,450	316,211	29,761
Twelve months ending June 30.	483,116	539,818	56,702

The most marked increase has been in the number of Swedish and Russian immigrants; the number of Italians was less in June, 1888, than in June 1887.

AMONG the 200 bills passed in this session of Congress, of a public nature, 51 bills authorize the bridging of navigable streams and waters over which Congress has jurisdiction. This increasing demand upon Congress has resulted in suggesting a general act making the Secretary of War and the Board of U. S. Engineers the final judges in such matters.

WORK on the United States building at San Antonio, Tex., has been delayed by a disagreement between the architect and the contractor. The architect insists upon the exact observance of the specifications and objects to the method of inserting binding stones. The contractor says the building is the best built public structure in Texas, and demands an inspector from Washington.

ONE of the attractions at the coming Paris exhibition, will, it is said, be an endless railway train, consisting of 400 platform cars. The line will be sunk so that the platforms will be on a level with the surface; the train will run slowly enough to permit most people to step on and off while it is in motion, but for the accommodation of elderly people, etc., a stop of 15 seconds every minute will be made to allow them to pass on or off or over the platform. The motive power will be electricity.

RAPID progress is being made on the Corinth ship canal, Greece. Nearly 3,000 men are employed on it, and the equipment includes 15 locomotives of large size. A new town is growing up at the western end of the canal, where the principal offices of the company are situated. The total cost of the work will be $6,000,000. The canal is nearly 6 miles long, will have a width of 125 ft. and be excavated to a depth of 25 ft. below sea level. A large part of the excavation is through solid rock.

IT is reported that two of the 67-ton guns of the English iron-clad *Rodney* have split their liningtubes; and other guns had to be substituted in the late manœuvres.

Aneroid Barometers.

BY E. A. GIESELER, C. E.

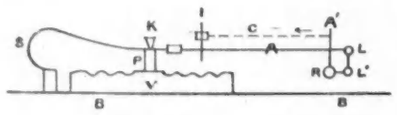
The motor of all aneroids consists in an hermetically sealed box, the air of which has been exhausted as completely as practicable, and the flexible sides of which will consequently perform certain motions, when the pressure of the atmosphere changes. These motions are, however, too small to be perceived by the unaided eye, and they are therefore transmitted to a suitable mechanism, by means of which they are magnified to such an extent that they can be discerned and measured.

The invention of the aneroid dates back to the beginning of this century, one of the oldest forms being the one constructed by BOURDON, in which the box has the shape of a tube sealed at both ends and bent into the shape of a circle. A small open space remains between the two ends, and diametrically opposite this gap the tube is fastened to a supporting plate. The cross-section of this tube is either rectangular or oval, and the direction of its greatest height or diameter stands at right angles to the plane of the circle into which the tube has been bent, which is parallel to the supporting plate.

When compressed air or steam is admitted into such a tube the inner pressure thus created will have the tendency to straighten it, on account of the excess of pressure exercised on the *greater* area of the *outer* circular side as compared with the *smaller* area of the *inner* circular side. Any increase of the inner pressure will result in a further flattening of the circle into which the tube has been bent, while a decrease of it will cause such curve to be sharpened.

Precisely the reverse will take place, when the tube has been exhausted, because then the acting force instead of being an *inside* pressure, will be the *outside* pressure of the atmosphere. The tube being held as described before at one point only, which is situated diametrically opposite the opening between the two ends, it is evident that the changes of form of the curve must result in movements of these ends; under the influence of high atmospheric pressure they will approach each other, while a decrease of pressure will widen the gap between them. The movements of the ends are transmitted by a simple arrangement to a hand pointing on a graduated dial. They are magnified either by levers acting on the *short* arm of the hand or pointer, or, when the latter is mounted centrally, by means of a toothed wheel and pinion.

This form of the aneroid has now-a-days been entirely superseded by another one in which the vacuum box has the shape of a flat cylinder into the upper and lower circular ends of which concentric grooves are pressed in order to equalize the motions performed by them under the influence of the varying atmospheric pressure. To the side of the vacuum box is soldered a small tin pipe, through which the air is exhausted. After this has been done the pipe is sealed and the upper and lower ends of the box are now deflected towards its interior by the pressure of the atmosphere, the amount



of such deflections for a given pressure being dependent on the strength of the plates. This must be sufficient to prevent too great a departure from the horizontal positions, in order not to strain the plates beyond their limit of elasticity. The movements are therefore necessarily small, a fall of $\frac{1}{10}$ of an inch in the mercurial barometer corresponding to an approach of about $\frac{1}{20000}$ of an inch of the plates of the vacuum chamber.

To measure such exceedingly small quantities, modern aneroids are provided with an ingenious mechanism invented by VIDI and later improved by NAUDET, the main parts of which are shown in the accompanying sketch.

To the base or foundation plate *B B* are firmly attached a laminated spring *S* and the vacuum chamber *V*. The latter carries upon its center an upright pillar *P*, which passes through an opening in the spring and presses on its upper side by means of the knife edge *K*. An elastic system is in this way formed by vacuum chamber and spring and the pulsations of the former will be imparted to the latter. The horizontal arm *A* is firmly attached to the spring and will therefore follow its movements. These will appear in a magnified scale at the end *L* and are transmitted by the two links *L* and *L'* to the rocker shaft *R*, which turns in bearings attached to the base plate but not shown in the diagram. The turning motions of *R* are further magnified by the arm *A'* and thence transmitted by a small chain *C* to the central shaft *I*, which carries the index pointer. The required tension on the chain is produced by a spiral spring acting on the central shaft. This spring and the bearings for the central shaft are not shown in the diagrams.

The graduation of the dial is made to correspond as nearly as possible with the reading of the mercurial barometer, and, like the latter, is expressed in millimeters or in inches. Perfect accuracy in this respect cannot be attained; there will always be required a certain correction for graduation. This and the corrections for temperature are the most important ones for practical work. The amount of the first one can be ascertained through a comparison with a mercurial barometer by means of an air pump, or through repeated comparisons under normal pressure. In order, however, to eliminate the influence of temperature during such comparisons, they should be made at 32° Fahr., which is the universally adopted basis of comparison to which all barometer readings are reduced.

The correction for temperature, according to BAUERNFEIND, increases in direct proportion to the increase of the same; for NAUDET'S aneroid it is subtractive for all temperatures above the freezing point, and additive for all temperatures below the same. In the absence of an apparatus for this purpose, its amount can be found approximately by exposing the instrument to the direct rays of the sun, after having previously taken a reading in the lower temperature of the room. Any change of pressure occurring during the time between the two readings must of course be taken into account.

A great number of aneroids that are in the market now are marked "compensated"; but this word should not deter the engineer from testing for himself the truth of the assertion, as many instruments so marked will show an appreciable deviation under changes of temperature. When the amount of this deviation is once known, it will, of course, not detract in the least from the serviceableness of the instrument.

The measuring of altitudes by means of the barometer is mainly based on two suppositions, viz.: firstly, that the atmospheric strata of equal pressure are horizontal; and secondly, that the temperature of a vertical column of air is equal to the arithmetical mean of the temperature observed at its top and at its bottom.

These two conditions are proably *never* fulfilled completely in nature, but they are *always* fulfilled more or less approximately. On the greater or smaller deviation from them of the actually existing conditions, depends the exactitude of the result in each case, leaving out of consideration of course avoidable errors of observation.

In accordance with the two principles mentioned the process of barometric measurement may be described thus: By means of the barometer, be it a mercurial or be it an aneroid, the *weight* of a column of air is determined and from the *observed temperature* of such column its length is found.

During observations for altitude, therefore, the temperature of the *air* as well as that of the *instrument* must be observed; the first one for the purpose named just now, the last one for the purpose of taking into proper account the corrections for temperature, by reducing both observations to uniform temperature. Besides this the observations made at the upper and at the lower stations must of course be corrected to graduation, so that thus their difference is made as nearly equal as possible to the difference that would have been obtained by using a mercurial barometer.

Having done this the difference of altitude between the two points of observations is obtained in a simple way from the following table, which has been taken from "Meteorological and Physical tables of the Smithsonian Institution."

Height in Feet of a Column of Air Corresponding to One-tenth of an Inch in the Barometer.

Barometer reading in inches.	Temperature of air in degrees Fahrenheit.					
	40°	50°	60°	70°	80°	90°
23.0	116.2	118.8	121.3	123.8	126.4	129.0
23.5	113.7	116.2	118.7	121.2	123.7	126.1
24.0	111.3	113.8	116.2	118.6	121.1	123.5
24.5	109.1	111.5	113.8	116.2	118.6	121.0
25.0	106.9	109.3	111.6	113.9	116.3	118.6
25.5	104.8	107.1	109.3	111.6	113.9	116.2
26.0	102.7	105.0	107.2	109.5	111.7	114.0
26.5	100.9	103.1	105.3	107.5	109.7	111.8
27.0	99.0	101.2	103.3	105.5	107.6	109.8
27.5	97.2	99.3	101.4	103.5	105.6	107.8
28.0	95.4	97.5	99.6	101.7	103.8	105.9
28.5	93.8	95.8	97.9	99.9	101.9	103.9
29.0	92.1	94.1	96.2	98.2	100.2	102.2
29.5	90.6	92.6	94.5	96.5	98.5	100.4
30.0	89.1	91.0	92.9	94.9	96.8	98.8
30.5	87.6	89.5	91.4	93.3	95.2	97.2

By way of an example of using the table, suppose 29.5 and 26.5 to have been the corrected readings, reduced to a uniform temperature, and 70° and 60° to have been the temperatures at, respectively, the lower and the upper stations, then we obtain from the table:

For 29.5 ins. and 70° Fahr. 96.5
For 26.5 ins. and 60° Fahr. 105.3

Mean 100.9

This mean multiplied by the difference of the two readings expressed in tenths of an inch renders the difference in altitude:

$$30 \times 100.9 = 3{,}027 \text{ ft.}$$

The use of this table gives results of sufficient accuracy for all practical purposes so that recourse to the complicated barometrical formula is not necessary. Other convenient tables are given in "The Aneroid Barometer" VAN NOSTRAND, New York, 1888, and in the above mentioned publication of the Smithsonian Institute.

In measuring heights it is of course always best to work with two instruments, continuous observations being made on one of them, which is kept at a fixed point and to which the readings of the other one are referred.

If only one barometer is used, reliable results can be obtained by taking a second reading on the first point, so as to find the change which has taken place in the atmospheric pressure.

Readings should always be taken in the same position of instrument, preferably the horizontal one.

In reply to an inquiry contained in ENGINEERING NEWS, of May 2, 1888, I would name among others the firm of Messrs. KEUFFEL & ESSER, of New York City, as having on hand a large assortment of the best make and most reliable holosteric instruments.

Preservation of Timber.

Some good advice about treating timber so as to insure its durability, is contained in a bulletin recently issued from the Forestry Division of the Department of Agriculture, Washington, from which we quote as follows:

Felling in early winter, say December, is to be preferred. Always remove the bark from felled timber to aid seasoning, but not from the standing tree. If winter felled, shape the timber to size within a fortnight after felling and have it placed on blocks, away from sun and rain, as much as possible, as it ought not to dry too rapidly. Sufficiently thorough seasoning for most purposes is obtained in from twelve to eighteen months, while for special work, according to the size, from two to ten years is required.

When timber is cut in the leaf it is advantageous to let the trees lie full length until the leaves are thoroughly withered, two or three weeks, before cutting to size. With conifers this is good practice at any season, and, if it can be done, all winter felled trees should be left lying to leaf out in spring, by which most of the sap is worked out and evaporated.

The best method of obtaining proper seasoning in a short time, without costly apparatus, is to immerse the prepared timber in water from one to three weeks to dissolve the fermentable matter nearest the surface. This is best done by running water; if such is not at hand a bath may be substituted, the water of which needs frequent change. Timber so treated, like raft timber, will season more quickly and is known to be more durable.

If practicable, the application of boiling water or steam is an advantage in leaching out the sap.

Never apply paint or any other coating to green or unseasoned timber. If the wood is not well dried or seasoned, the coat will only hasten decay.

Good coatings consist of oily or resinous substances,

which make a smooth coat, capable of being uniformly applied; they must cover every part, must not crack, and possess a certain amount of plasticity after drying. Coal tar, with or without sand or plaster or pitch, especially if mixed with oil of turpentine and applied hot, thus penetrating more deeply, answers best. A mixture of three parts coal tar and one part clean, unsalted grease, to prevent the tar from drying until it has had time to fill the minute pores, is recommended. One barrel of coal tar will cover 300 posts. Wood tar is not serviceable, because it does not dry.

Oil paints are next in value. Boiled linseed oil or any other drying vegetable—not animal—oils, are used with lead or any other body, like pulverized charcoal, to give substance. Immersion in crude petroleum is also recommended.

Charring of those parts which come into contact with the ground can be considered only as an imperfect preservative, unless a considerable layer of charcoal is formed, and if it is not carefully done the effect is often detrimental, as the process both weakens the timber and produces cracks, thus exposing the interior to ferments.

Suburban Railway Stations.

As a beginning in a series of articles relating to construction on and about railways, now in preparation for this journal, we present some notes on the design for a suburban station of moderate cost.

Plans *A* and *B* are original designs for an ornamental passenger station of following dimensions: Main building 24 ft. wide by 40 ft. long with extensions at ends 9 ft. wide by 18 ft. deep. Height of ceiling of main building 16 ft.

Buildings to be brick with stone base, all outside walls above stone base to be faced with Philadelphia front brick. Inside walls above wainscoting to be faced with white enameled brick. Jambs and soffits of all window and door openings, on outer surface of all walls, to be bordered with stone groins, rock faced, same as stone work between water table and sill course, both of which will be neatly dressed.

Cornice on inside at top of wall to be formed of terra-cotta with encaustic tile fringe. Tower to be banded with terra-cotta. Roof to be covered with terra-cotta tiles, or Bangor slate. Chimneys of terra-cotta, both above roof and below, to start from ornamental terra-cotta mantels furnished with Eastlake fire place fixtures and encaustic tile hearths. Flooring throughout to be granolithic laid off in blocks and tinted, with border around rooms.

Roof to be open with dressed and chamfered truss members, and purlines: all of yellow pine. Roof sheathing to be double, first course, or thickness, to be of narrow beaded and reeded yellow pine; second course to be of dressed hemlock laid with close joints.

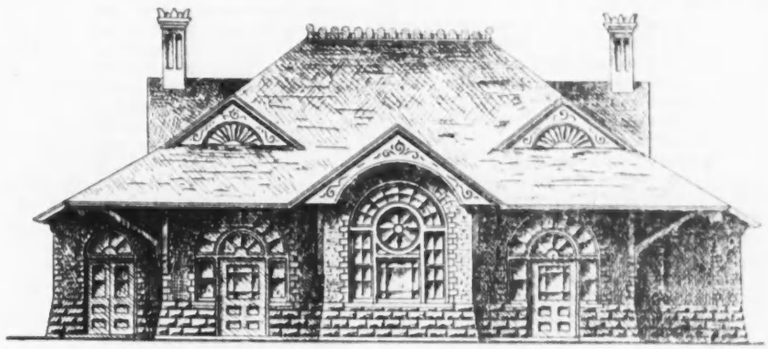
All of the inside wood work, wainscoting, jambs, architraves, etc., to be of white ash finished in hard oil and rubbed down in stained antique oak style. The wood work of the closets, baggage room and ticket office to be finished in same style, and each room to be provided with the necessary and appropriate fittings.

All sash to be hung with weights and to be 1¾ ins. thick, glazed with French sheet double thick glass Upper sash to be bordered with cathedral glass delicately tinted.

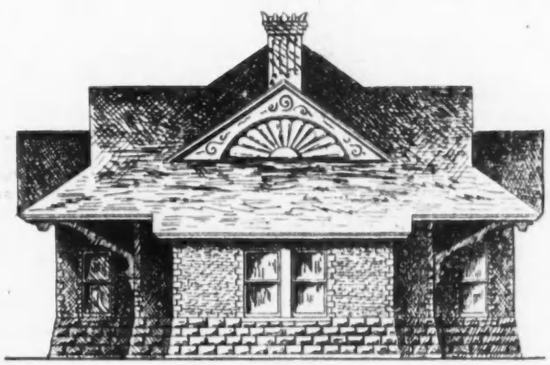
All outside doors to be of ash 2 ins. thick, with panels arranged as shown, and to have iron thresholds; or saddles. All hardware for trimmings and furniture to be of real bronze.

The overhang of roof to be supported on yellow pine truss brackets resting on cut stone corbels built in the wall. All of the members, purline, ceiling, etc., of overhang to be of dressed yellow pine, finished in hard oil. The building should be located about 22 ft. from the nearest rail of track, and the fixed plank of the platform should terminate within about 2 ins. of the ends of cross-ties for reasons obvious to a railroad man. From the end of platform, plank can be laid longitudinally to fill up the space between it and the rail, and spiked to the cross-ties. The platform at ends and rear of building should generally be not less than 8 ft. wide. All platforms should descend outward ¼ in. per ft. The floor of building should be about 7¼ ins. above highest portion of platform.

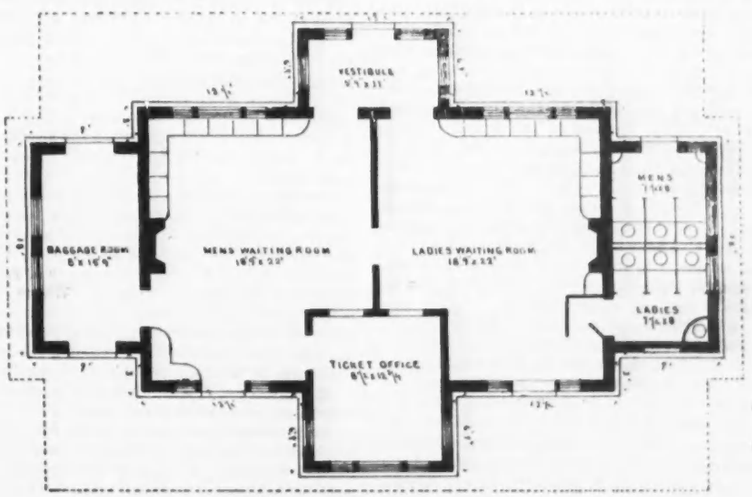
At each end of the main platform there should be about 75 ft. of 8 ft. train platform. All platforms to rest on 6 × 6 in. yellow chestnut sleepers firmly bedded in coal ashes, or locomotive cinders and to be composed of 2 in. Michigan hard pine, well worked, and laid close, in widths not to exceed 10 ins., and securely spiked to the chestnut mud sills.



Front Elevation of Suburban Railway Station.



End Elevation.



Floor Plan.

Lifts on Canals.

Mr. L. F. VERNON HARCOURT, in a paper read recently at the Conference on Canals and Inland Navigation, held in London, said that hydraulic lifts for connecting different levels in canals were coming into favor. A simple lift with counterbalancing troughs was used many years ago on the Grand Western Canal for raising and lowering 8-ton barges a distance of 46 ft., but it was subsequently abandoned. The system of hydraulic lifts now existing is of comparatively recent origin, the first one having been built at Anderton in 1875. On this lift the difference of level is 50½ ft.; and the barges are raised or lowered in two wrought-iron troughs, 75x15½ ft., with 5 ft. depth of water, each resting on a central piston rod, 3 ft. in diameter, working in two hydraulic presses underground, which can be connected at pleasure, making the troughs counterbalance one another. One trough accordingly ascends as the other descends, the motion being imparted by removing 6 ins. of water from the lower trough; and only the final lift of about 4½ ft., required when the descending trough reaches the water in the lift pit, has to be effected by hydraulic power. The whole lift is accomplished in 2½ minutes, and one 100-ton barge can be transferred from the river to the canal, and another from the canal to the river, in eight minutes, with an expenditure of only 6 ins. depth of water over the area of one trough, and the power required for the final short lift.

The canal lift recently opened at Les Fontinettes near St. Omer, France, was designed by EDWIN CLARK, C. E., and takes the place of five locks. The height of lift is 43 ft.; each trough is 132¾ ft. by 18¼ ft., containing a depth of 6½ ft. of water and weighing 700 tons, and accommodates barges of 300 tons.

On the Canal du Centre, in Belgium, there is a rise of 220 ft. in a distance of only 5 miles, and this is to be surmounted by four hydraulic lifts similar to those described, but still larger.

Notes on the Pollution of Streams.*

BY RUDOLPH HERING, C. E.

The proposition of permanently discharging the sewage of Chicago into the Desplaines and Illinois rivers recently gave me an occasion to inquire somewhat closely into the existing facts concerning the supposed self-purification of polluted streams. Owing to circumstances, this inquiry is not completed, and may not be for the present. While I therefore regret that I cannot give you a paper on the subject, I believe that a few data and some inferences may perhaps interest you at this time, and perhaps be of some value, in view of the importance the subject is gaining in many parts of our country. The Ohio River valley will soon require serious attention. Its numerous cities, some of them quite populous, discharge their sewage into the same river from which they take their water-supply. Typhoid fever is unusually prevalent in the valley. Likewise, the Schuylkill river furnishes a number of small cities, and finally Philadelphia, with water, after receiving above the latter city the water-closet drainage from 27,000 persons, and the wash-water drainage from 85,000 persons.[1] Here also the death-rate from typhoid fever is high. And a large number of other streams are beginning to cause trouble from similar conditions, though perhaps of less magnitude than those mentioned.

Evidently, it is becoming a pressing question to know with greater certainty just how far we may safely carry this system of pollution, or whether we must entirely abandon it. Much work will yet have to be done, and many investigations will have to be made, before the subject is cleared up in a way that will allow of a treatment which is just to both those who must have drainage, and to those who, residing farther down on the same stream, must have potable water.

In discussing the question of water pollution, of setting up a standard of purity, of a minimum proportion of sewage, or perhaps of the necessity for its entire exclusion, a distinction must be drawn at the outset. The problem must be viewed very differently when the sewage-polluted water is to be used for potable purposes, or when, as often occurs, it is simply to be inoffensive, not destructive to fish, nor objectionable to manufacturing interests and to the residents along its course.

With reference to the first case, we have a large number of observations, data, and opinions, yet withal they are insufficient to give a positive guide to the selection of a water-supply in every case. The engineer who is employed to advise on the selection, is sometimes confronted with great difficulties, from the want of reliable evidence regarding the real danger from pollution. Is he to reject a palatable water, and perhaps by far the most economical source of supply, because 50 or 100 miles above, another community discharges some sewage into it? Is he to be governed at all by the degree of dilution it has received, and by the number of days or weeks since the polluted water has had a chance, during its flow, to convert the sewage matter into organic compounds? And is he to consider the æration of a stream as effecting the gradual destruction of disease germs in the same measure as it effects the destruction of the dead organic matter?

Before engineers can receive definite answers to these and other questions, from the medical and allied professions, they must, in order to help their clients, continue to say as follows: We know, as for instance in the case of Plymouth, Pa., that clear and tasteless water from a mountain brook may cause an epidemic of typhoid fever, by being used for drinking purposes within a few miles of the point where the dejecta of a single patient entered the stream. We do not know the conditions under which the dangerous germs may be deprived of their vitality in a living stream. We therefore assume, for want of further evidence, that in water previously polluted, but through dilution or other cause containing a minimum quantity of organic matter and a maximum of dissolved oxygen, the danger from the pathogenic germ gradually vanishes. And to be reasonably safe, we further assume that potable water must not only be of good quality, chemically speaking, but that before being used it must have run in the stream for a considerable distance, depending upon circumstances, after it has been even slightly polluted by sewage matter, whether detectable by chemical analysis or not.

In an investigation of the projects for a new water-supply for the city of Philadelphia, which was undertaken a few years ago, the chemical work was supplemented by a survey of 450 sq. miles of water-shed, showing the location of every farm-house, building, manufactory, or other possible sources of pollution in their relation to the water-courses. In this way the actual and possible pollution could be readily determined, as well as the practical way of preventing it, in each case. Such surveys, which in a smaller way have often been undertaken, I consider invaluable to the discussion of water-supplies likely to suffer from sewage discharge, and the results should naturally have a far greater weight than those of the chemical analysis of the water at the foot of the drainage area.

The present researches in bacteriology will no doubt soon throw an abundance of light on this question; and the engineer is anxiously awaiting the results, in order that he may solve the practical problems in the selection of a water-supply, if possible with a degree of certainty and safety approaching that which he secures when dealing solely with the laws of mechanics.

The second case I referred to, concerns polluted water *not* to be used for potable purposes, perhaps because it is altogether impracticable to preserve a high standard of purity, or because better sources for a domestic supply are available. The Desplaines and Illinois rivers, for instance, receive the sewage of Chicago and other towns, and no drinking-water is obtained from the same, except some at Peoria, 160 miles below the main sources of pollution. The Blackstone river in Massachusetts also serves as a sewer, and will probably always continue to do so; and the Schuylkill river in Pennsylvania will, I believe, likewise have to be entirely abandoned to drain the cities and manufactories of the valley.

There are a number of other streams in our country which will have to perform this duty, and if there are other and better sources for a city's supply, this use of a river cannot reasonably be objected to on economical grounds.

The question then arises: How much sewage should be permitted in such a case? In other words, what is the proper standard of purity to satisfy the various interests? This is the subject on which I endeavored to get some light in the Chicago investigations, but, as I said, the data are not complete.

The first point to settle is a proper measure for the permissible pollution. This is best assumed as being the quantity of water which can safely receive the drainage from a unit of population; in other words, the least number of cubic feet of water per minute which should flow down the stream for say every 1,000 persons draining into the same.

By using this measure we eliminate the difficulties arising from a varying quantity of water consumption and dilution of sewage before reaching the stream. In England, the quantity of sewage ranges from 30 to 60 galls. per head; in America, from 50 to 150 galls. per head. But the quantity of refuse per inhabitant does not vary much. Where factories discharge considerable waste matter of a particular kind, or where large slaughtering establishments drain into the rivers, some additional allowance for them may be required, but otherwise the amount of waste matter per inhabitant will be pretty constant, and therefore convenient as a measure.

The problem then is: How much running water must we have to dilute the sewage from every 1,000 persons in order to make it inoffensive, not objectionable to manufacturing interests, nor destructive to fish?

The standard for inoffensiveness must of necessity be one of personal judgment, and can only be approximate. The admissible sewage pollution of water used for manufacturing purposes depends on the particular industry, some mills requiring a much higher standard than others; and unless in any particular case the nature of the industry is a governing element, we are again obliged to resort to personal judgment as to what is a fairly clean water for average cases. A standard of pollution which, thirdly, will prevent the destruction of fish depends upon the particular species which it is desired to retain. Yet, as we find fish living in sewage-polluted water which is sufficiently diluted to answer the first and second requirements, we can usually ignore this one, except in occasional instances, where it assumes special importance, and where special experiments will become necessary.

There are three ways in which we may get a solution of the problem from this point of view. In the first place, we can obtain a sample of the average sewage per inhabitant from a sewer, and mix it with enough water to make it what is believed would be unobjectionable, and thus determine the dilution. This method can be applied in small towns,—not so well in large cities where the sewage varies in different sections, owing to different classes of population and manufactories.

In the second place, we can observe the gradual increasing pollution of a water-course, caused by the successive discharge of a number of sewers, and, after determining the point at which we find the condition of the river to have become objectionable, either to the senses or for use, we can measure the flow, and find the population which has drained into it at this point.

It is usually difficult to get a satisfactory answer in this way, owing to the imperfect mixture of the sewage with the river water until they have run a long distance. It was intended, however, to make some observations on this point in Chicago, where the river serves as the main outfall sewer for the city, with the hope of fair results, notwithstanding the additional difficulties there encountered, due to the frequent but irregular stirring up of the sludge by the tugs and vessels. But, owing to want of funds, this, as well as other inquiries, has not been undertaken.

The third way in which we can throw light on the question is to observe the gradual so-called self-purification of polluted streams. On this subject, taking a little broader view than required for the above special purpose, I have the following notes to present:

It has been asserted in England by Drs. MILLER, ODLING, and LETHEBY, that organic matter of sewage is rapidly oxidized during the flow of a river into which it is discharged, and that if the dilution is at least twenty times, the sewage[2] will not only be made inoffensive, but be utterly destroyed within a "dozen miles or so." But the Rivers Pollution Commission of Great Britian, in 1878,[3] after a careful direct investigation, prove that this assumption is altogether wrong so far as the rapidity of oxidation is concerned, and state that there is no river in England long enough to allow of a complete disappearance of sewage-matter discharged into it.

The main causes of the apparent disappearance of such matter are *dilution*, *subsidence*, and *oxidation*. Let us consider them for a moment.

When sewage is discharged into a comparatively large volume of water, it becomes dispersed throughout the mass, and lost to sight and even to chemical tests if the dilution is great enough.[4]

The measure of relative dilution can usually be ascertained by the mineral salts in solution, and, particularly by the chlorine in common salt conveyed to the streams by the sewage, because they are not liable to undergo any change which would cause disappearance.

Subsidence of the heavier organic and mineral matters of sewage has a marked influence in clarifying a polluted river. It is observed immediately below outfall sewers, and is caused by a reduction in the velocity of the sewage after emerging from them, which permits the suspended particles to deposit. This deposit or sludge continues to undergo decomposition until the matter is reduced to its inorganic compenents. During floods the increased velocity of the water stirs it up, mingles it with the earthy matter generally suspended in flood-waters, and allows it to be again deposited at another place lower down the river, usually in a less objectionable condition than before. Factory refuse often contains chemical agents, such as lime, alum, and metallic salts, which precipitate much of the sewage matter, and thus tend to increase the amount of

*From Transactions of the American Public Health Association; Vol. XIII.

[1] See Report Philadelphia Water Department, 1885.

[2] English sewage is from 2 to 3 times less dilute than American sewage.

[3] Sixth Report, 1879.

[4] According to Dr. Konig ("Pollution of Water-Courses." Berlin, 1887) the minimum quantity of organic matter which can be detected by chemical means is 1 milligram in a dilution of 1:1,000,000; of ammonia 0.05 milligram in a dilution of 1:20,000,000. Chlorine can be detected as 0.1 milligram in a dilution of 1:10,000,000.

deposits. Metallic oxides unite with the sulphuretted hydrogen of decomposing sewage, and form insoluble compounds and harmless deposits.

Oxidation and total destruction of sewage matter by decomposition was for a long time thought to be the main cause for the clarification of polluted rivers. To-day it is known to be but a minor cause, compared with dilution and subsidence; and if the sewage is discharged in a fresh condition into a stream of water, its destruction is in part due to fish and other aquatic animals. Some of the refuse from stockyards is disposed of, no doubt, in this way. Most of the sewage, however, is decomposed or oxidized, as it is usually termed, by the myriads of microscopic plants, microbes, or bacteria contained in both air and water, which at once seize upon the dead organic matter. It is true that chemical changes, not caused by life, assist in converting the organic matter into simpler compounds, but their effect is comparatively insignificant.

The English River Pollution Commissioners[5] state that sewage oxidation is more active in sunshine than in shade, and is almost arrested at night, and when the thermometer approaches the freezing point, showing its dependence on the conditions favorable to the lower orders of life. Since then it has been quite conclusively proven that the question of sewage oxidation in a polluted stream, or even in the soil of sewage farms, is practically one of a sufficiency of micro-organisms and of air and other conditions that sustain their life.

Dr. DUPRÉ[6] sterilized sewage, and kept it for weeks without the slightest change. By adding a little non-sterilized sewage, decomposition at once began. Mr. WARRINGTON has found similar evidence. Dr. EMMICH[7] has shown that sterilized sewage, continuously aerated by sterilized air, did not oxidize perceptibly, nor purify itself at all.

If the aeration of rivers can be kept up to the highest practicable point, it would on a summer day offer the most favorable conditions for a disappearance of the organic matter.

Applying these facts, we can say that for purifying the sewage discharge into a river, oxidation can be depended upon only to a limited extent, because of the comparative slowness with which it takes place. Subsidence of the heavier matter tends to clarify it before it flows many miles; dilution with a sufficient quantity of clean water prevents an offensiveness almost at once; but oxidation requires many days under continuous aeration of the river.

Therefore, by examining the actual purification of polluted streams, and realizing that oxidation is a comparatively small factor, we are furnished with some evidence as to the proper dilution of sewage in the case under consideration, which cannot be far wrong, and may serve a useful purpose until more information is obtained.

The facts which are now available are not many, because opportunities to establish the same on a large scale, which alone is of practical value, have seldom offered.

In our country instances are the Desplaines and Illinois rivers, receiving the sewage of Chicago; the Blackstone river in Massachusetts, with the sewage of Worcester; and the Merrimac river in Massachusetts, with the sewage of Lowell and Lawrence. In Europe the most instructive case is the river Seine below Paris, at the time when it received all the sewage from that city. Other rivers are the Irwell, Mersey, and Darwen in England, and the Oder, Isar, and Elbe in Germany.

It would be tedious to describe to you in detail the changes taking place in each case, and I will confine myself to some general remarks. Profiles were platted of some of these streams, showing their general descent, to indicate their relative facilities for oxidation, also the average dry weather flow at all points, gradually augmented by the affluents. The results of the chemical analyses were platted at the respective points.

It was clearly shown how the increased dilution lowered the percentages of albuminoid and free ammonia almost in exact proportion to the increase of dilution, and that the apparent purification, which was often supposed to be due to oxidation, was due mostly to greater dilution.

The sewage of Chicago, mixed in a proportion of about one of sewage to four of lake water, or of 60 cu. ft. per minute per 1,000 persons, is pumped into a canal, and flows, without further increased dilution, for nearly 30 miles in about as many hours, and its condition, which is quite offensive, is not changed very much. Then it descends over several dams, mingles with the water of the Desplaines river, and within a few miles it is visibly improved. When, 45 miles below Chicago, it unites with the water of the Kankakee and forms the Illinois river, the water causes a dilution twice as great as that in the canal, and the river loses its offensiveness during the greater part of the year. At Peoria, 158 miles below Chicago, the sewage has a dilution of nearly three times that in the canal, and, except when ice has covered the stream for some time, no odor can be detected, and the water is even partly used for the city's supply. Here there is a flow of 170 cu. ft. per minute for every 1,000 persons draining into it.

Owing to the fact that the velocity in the canal is greater than that in the rivers at its two ends, deposits are formed in the Chicago river before entering the canal, and again in the Desplaines river after leaving it.

I will say that the analyses upon which these deductions are based were made under the direction of Dr. JOHN RAUCH, Secretary of the State Board of Health of Illinois, and that the conclusion that in winter 180 cu. ft. of water per minute per 1,000 persons draining at Chicago would be sufficient to prevent objectionable conditions all along the river is originally his.

The Blackstone river, in Massachusetts, which is quite foul below Worcester, and receives much additional sewage on its way, becomes unobjectionable at ordinary times for all but potable purposes about 15 miles below the city,[8] with a dilution at the rate of 140 cu. ft. per 1,000 persons draining into it, together with considerable manufacturing refuse, and after there has been a chance for complete subsidence and some oxidation due to a large number of dams.

In Paris the sewage of nearly 2,000,000 people was turned into the River Seine before the irrigation fields were put in operation. The organic matter in this sewage per inhabitant is, from the analysis, hardly one-half that of our sewage, because excrementitious matter was almost wholly excluded from the sewers. The dilution which rendered the polluted river entirely inoffensive in summer was 60 cu. ft. per 1,000 people after a flow of 14 miles and after subsidence of the suspended matter had taken place.

If we reduce the recommendations of Dr. MILLER and others, for England, as mentioned above, to our measures, we find that they believe a dilution of say 120 cu. ft. of water per minute for 1,000 persons to be sufficient to guard against offensiveness. But this recommendation probably applies to small cities not devoted to manufacturing.

By comparing these results, and also those of the other rivers mentioned, we can observe much similarity and consistency, and, for the present, we may draw the following inference: Rivers not to be used for water-supplies, but to be inoffensive to communities residing a few miles below, to remain fit for ordinary manufacturing purposes, and to sustain the life of fish, may receive the sewage from 1,000 persons for at least every 150 to 200 cu. ft. of minimum flow per minute, supposing that natural subsidence of the heavier matter takes place immediately below the town discharging the sewage.

Where, for some reasons, it is necessary to dilute it at once so that it is quite inoffensive *before* subsidence, which cases are rare, a somewhat greater dilution may be required. Inasmuch as the flow governing the minimum dilution occurs in summer, no attention need usually be paid to the larger dilutions required in winter, because the natural flow of the water is much greater at such time.

Beyond the above limit it appears to be advisable, when arranging for a sewage disposal, to resort to its purification at once by land or other filtration, or by chemical precipitation, in order to prevent the river water from becoming objectionable to others.

It is to be hoped that more investigations will be made on this subject, so that the limits, which sometimes may be very important from an engineering and financial point of view, can be more closely drawn. While the above figures may be a useful guide in many instances, yet they are but empirical formulæ, to be used only by those who thoroughly understand the subject, and to be applied only in cases similar to those from which they were deduced.

[5] Sixth Report, 1879, p. 176.
[6] Proc. Inst. C. E., vol. 88, p. 215.
[7] Chem. Central Blatt, 1885, p. 333.
[8] Seventh Annual Report of the Massachusetts State Board of Health.

The Manchester Ship Canal.

(Continued from page 62)

The latest reports concerning this work state that the rate of progress is more than sufficient to insure the completion of the whole canal in the stipulated time. To fulfill the conditions of the contract and complete the work in four years from the time of beginning, the monthly excavation must be 1,000,000 cu. yds. and not 100,000,000, as a typographical error made it appear in our issue of July 28. We proceed with our detailed description of the work.

SECTION No. 6.

This division extends from 21¼ miles to 25¾ miles, and is in charge of an agent and sub-agent, representing the contractor, and an engineer, three assistants, one draughtsman and the usual other staff representing the Canal Co. About 400 acres of land are required on this length of 4½ miles. Of the total excavation of 5⅝ million cubic yards, almost all will be earth, there being only about ¾ of a million cubic yards of rock.

The Latchford locks, situated at 21¼ miles, will effect a change of level of 14½ ft. in the main canal.

The Mersey will be crossed five times by the canal between 22 miles and 24½ miles; at 22¾ miles a large river diversion will be cut, doing away with two crossings, and the river bed around the disused bend will be filled up. Between 23½ miles and 23⅝ miles the river bend to the southward of the canal will all be filled up; no river diversion is necessary here, because the main water and all the traffic of the Mersey and Irwell navigation is now carried through a river improvement to the northward of this point. From 24¼ miles, where the Bollin joins with the Mersey, onward to Manchester, the canal is continually crossing and re-crossing the river, so the latter is to be filled up and the canal will take its water. The main earthworks on section No. 6 were commenced about the middle of last March, and at the end of May 330,000 cu. yds. had been moved.

At 21¾ miles a cutting 70 ft. wide and 14 ft. deep begins, the work on which is being done by hand. The next cutting, at 22⅛ miles, is in sandy material and the work is being done by two steam crane excavators of English make.

In both of these excavators a frame carrying a bucket is fixed on to the jib of an ordinary crane, and the upward pull of the bucket, to make the cut, is caused by the hoisting chain over the point of the jib, acting in a similar manner as if the crane were lifting ordinary loads. The racking motion in one, the Whitaker excavator, is given by an oscillating steam cylinder working on a system of levers. The racking motion of the other, the Smith machine, is caused by a chain direct from the engine shaft, working gearing on the bucket arm.

At 22¾ miles a river diversion is being made through sand. At the end of May ¼ mile had been taken out 160 ft. wide and 7 ft. deep.

The work is being done by hand labor, by three barrow hoists worked by horses, one double barrow hoist with hoisting engine, and one 10-ton steam crane, with 70 ft. jib were provided for lifting the stuff out of the excavation; the steam crane worked four one-yard skips, into which the stuff was loaded and some small trolly roads were laid to run the skips within the radius of the jib. In the center of this excavation a sump has been sunk, and one pulsometer pump is sufficient to keep the work dry.

From 22⅛ miles to 23¼ miles some stripping and hand work has been done preparatory to using steam excavators. At 23½ miles a cutting has been opened by hand and the work will be continued with a Lübecker excavator.

One of the main depots for the reception and distribution of plant is situated near Latchford, on this section, the site having special advantages, both for railway and water transportation. Cars are delivered there in pieces and are assembled and sent out on the line. A small 4-wheeled locomotive with 10-in. cylinders and a 5-ton and a 3-ton steam traveling crane are used exclusively for moving material in the depot. Before connection was made with the railway a quarter of a mile away, locomotives were hauled that distance by an 8-horse traction engine, wide tired wheels being placed under the locomotives.

The important plant on this section consists of five Ruston & Proctor's steam navvies, one Lübecker excavator, one Whitaker excavator, one Smith steam crane excavator; nine locomotives, 10 to 15-in. cylinders; six portable engines, 5 to 20 H. P.; two 2½ ton, one 5 ton, and one 10 ton steam cranes; one centrifugal pump, one chain pump, one Tangye's pump, six pulsometers; 250 cars, and 650 barrows. There are seven miles of temporary railway and five trestle bridges, averaging 120 ft. in length.

SECTION No. 7.

This length extends from 25¾ miles to 30 miles. Some of the work of Section No. 6 has, however, fallen to the engineering staff of this division. At the end of May there were 600 men employed here. The principal plant consists of seven locomotives from 10-in. to 13-in. cylinders, six Ruston and Proctor's steam navvies with 1¼ yard buckets, one Priestman grab excavator, one 10-horse and one 16 H. P. portable engines, two 2½-ton and one 5-ton steam traveling cranes, one 6-in. centrifugal pump, one Tangye's pump and three pulsometers, 300 cars and 800 wheel-barrows. The cutting at 25 miles has been taken out to the full width at the top, 300 ft. and to a depth of 15 ft. At 24¾ miles a cast-iron cylinder has been sunk for a permanent sump to drain this part of the work.

The land required for the canal, railway deviations and river diversions amounts to about 550 acres. The total excavation will be about 6½ million cu. yds., of which 440,000 cu. yds. are estimated to be rock. At 27¼ miles a deviation for the Stockport Glazebrook Railway will cross the canal on a viaduct of 153 ft. span on the skew, carrying four tracks. The clear headway will be 75 ft. There will be four approach arches, each of 37 ft. span. The same deviation crosses the Mersey on a viaduct of three spans of 115 ft. each.

There will be another viaduct crossing the canal at 28½ miles, with span of 166 ft. on the skew and giving 75 ft. clear headway. There will be four arches on the approaches, each of 36 ft. span. At 28¾ miles the Irlam locks will occur, making an alteration in the water level of the canal of 16 ft.

(TO BE CONTINUED).

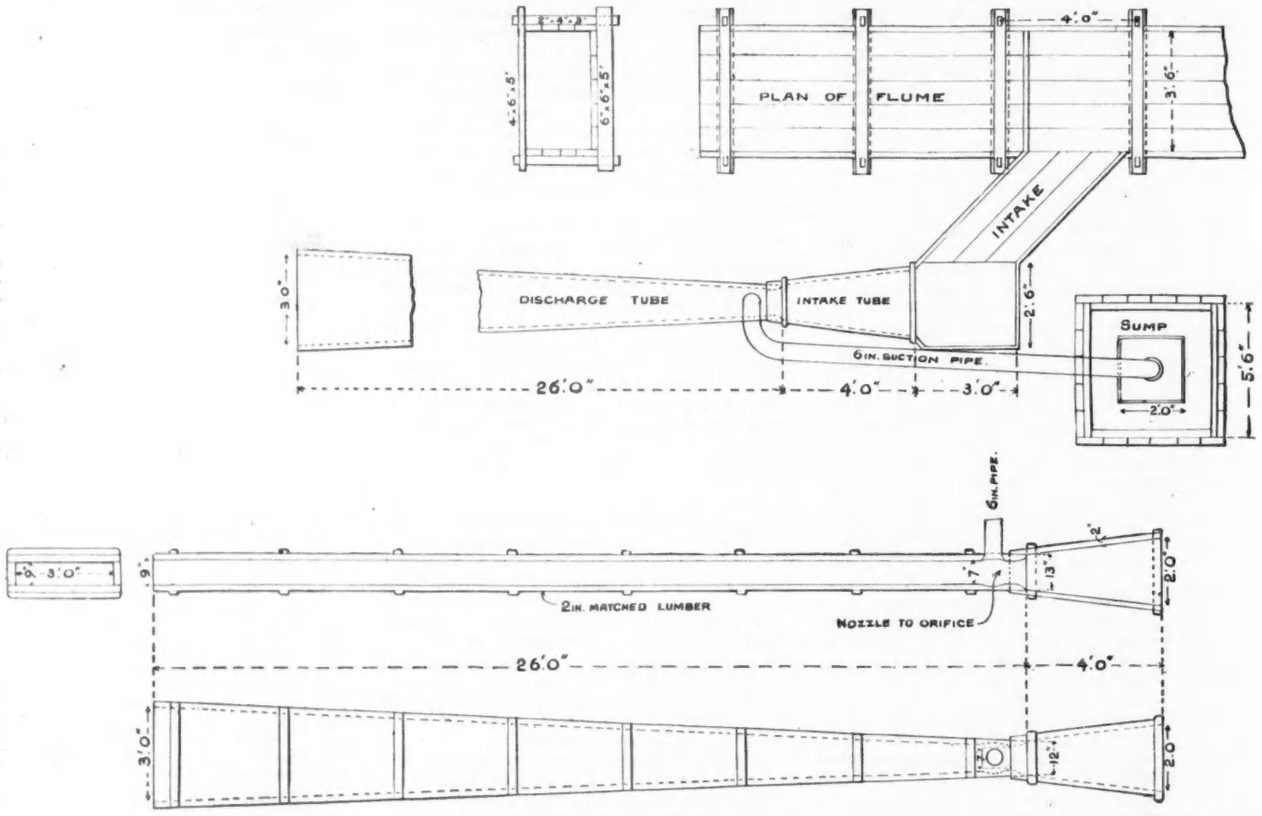
A Contractor's Siphon, or Water Ejector.

We are indebted to Mr. G. N. MILLER, Asst. Eng. of the St. Paul, Minn., Sewer Department, for the following illustration and description of a simple device for draining water from sewers or other excavations in wet soil.

Mr. MILLER states that the city of St. Paul for sometime past has had in process of construction a large storm water sewer, which is being built along the bed of what is known as Trout Brook. A large amount of running water coming from the brook, and also from a sewer outlet, had to be taken care of by the use of a flume, which carried it to a point beyond the terminus of the new sewer. During the progress of the work the sub-soil water entered the trench in such quantity as to require the use of a steam pump to handle it. About a month ago the boiler of the engine employed in pumping exploded, killing three men and injuring several others, besides resulting in the total destruction of the engine and that when air is admitted into a suction pump, the charge of water is lost, and the discharge is immediately stopped. But in this case, although taking in considerable air, the pumping is continuous and the discharge does not appear to be materially diminished.

The cost of the ejector was about $50, which, with a slight additional expense for setting up, represents the total outlay since the pumping began over two weeks ago. The cost of pumping with an engine was about $8.00 per day of ten hours.

The ejector has already doubly paid for itself, and as it will require another month to complete the sewer, the saving to the contractor, in a pecuniary way alone, will be considerable, to say nothing about the trouble and delay attending the use of other appliances for getting rid of the water in the trench.



A Contractor's Water-Ejector.

The Columbia Canal.

In 1887 the Legislature of South Carolina turned this enterprise over to the city of Columbia, thus freeing the State from what had been considered a heavy drag upon it.

The canal will connect the Congaree and Broad rivers and be about 5 miles in length. It is the last link in a series of waterways which will give Columbia and the Broad river and its affluents a water route to the sea at Charleston. The depth of the canal will be 10 ft.; its width at the top about 150 ft. A section of one mile, including the most difficult part of the work, has been completed. The canal is expected to furnish about 12,000 horse power, the value of which is estimated to be $60,000 per annum. Thirty-year six per cent. bonds to the amount of $200,000 have been authorized, and upon these the interest will be guaranteed by the city of Columbia. The friends of the enterprise predict that many manufacturing establishments will spring up in Columbia after its completion.

THE matter of the disputed boundary line between the States of Tennessee and Virginia, is to be settled by a suit in the United States Supreme Court.

Railways in the Argentine Republic.

The following is from the address of President JUAREZ at the opening of the Congress on May 8, and while the complaints against the railway companies are backed by threats of the withdrawal of guarantees, it is stated by some of the English financial papers, that the arguments are not wholly on the side of the Government, but that the companies have another side of the question.

"Of the seventeen railways recently conceded, thirteen enjoy the guarantee of the State. These guaranteed lines represent a total length of 4,975 miles. The aggregate length of the other lines is 795 miles. The contracts for the following guaranteed lines have been signed:—Tartagal Railway; Reconquista & Formosa Railway; Bahia Blanca & Villa Mercedes Railway; San Juan & Salta Railway; Chumbicha, Tinogasta & Andalgala Railway; Goya & Monte Caseros Railway; Resistencia & Metan Railway; San Christobal & Tucuman Railway. Moreover, a contract has been drawn up for a railway from this city to Chile, a distance of 775 miles; as also the contract for a line from Belgrano to Tigre, which does not enjoy a Government guarantee. The line from San Juan to Cabra Corral in Salta is being traced. That from Mendoza to San Rafael will be shortly concluded. The branch of the Northern Central extension to Salta *via* Mojotoro has been completed, and in the course of this year the surveys of the line from Cobos to Salta *via* Lagunilla will be commenced. The line from Lerma to Cabra Corral has been surveyed and traced. Of the Chumbicha, Tinogasta & Andalgala Railway, 43½ miles have already been traced. The plans for the bridges on the extension works of the Northern Central Railway are being prepared and will be shortly completed. The Board of Public Works has, moreover, examined the plans of the following lines;

Transandine, Central Corrientes, Sunchales to Tucuman, Yerbas, and Pergamina branches, Resistencia to Formosa, Santa Fé to Cordoba, and Resistencia to Metan. The state of railways in course of construction is as follows: Northern Central extensions: the section from Tucuman to Chilcas was completed last year. Twenty-one iron bridges have been constructed in this section. With regard to the branches from Dean Funes to Chileciro and from Chumbicha to Catamarca, in charge of Messrs. Gonzalez & Co., the earthworks have been begun, and the rails are being laid. In the extensions beyond Chilcas very little has been done. The company has to contend with many unforeseen difficulties, for which the State makes due allowance—such as the outbreak of cholera in Salta, an epidemic that proved more fruitful in alarms than in disasters. Nevertheless the Government is not pleased with the delay, as the stipulated terms are fast drawing to a close. The Government will exert itself as much as possible to infuse some activity into the prosecution of the works, in order to satisfy the legitimate aspirations of two important provinces. The line from Buenos Ayres to Mercedes, 67 miles in length, has been completed and opened to public traffic. On the Transandine section from Mendoza to Valparaiso, 6.2 miles of track have been laid, and the navvies are at Kilo. 35 at the mouth of the Rio Mendoza. The company expects to reach Kilometre 100, that is Uspallata Pass, by the end of the year. For the construction of the railway from Monte Caseros to Corrientes and Posadas, the company is already importing the necessary materials, buying lands for the line, and preparing to commence work as soon as possible. On the line from Sunchales to Tucuman the navvies are at work on an extent of 155 miles, and 25 miles of rails have been laid.

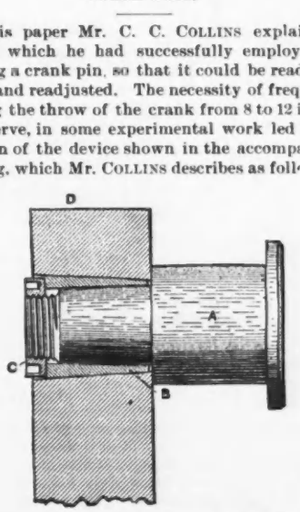
"*Guarantees on Railway Capital.*—Before I proceed to speak in reference to the heading of this paragraph, I beg to call your attention to the figures showing the traffic movement of the railways in operation. You will thus have an opportunity to draw some important conclusions. The railways cover 3,909.72 miles, have carried 7,657,409 passengers, and 3,705,876 tons. The gross receipts amount to $23,805,722. Working expenses were $13,177,772, the net earnings being therefore $10,627,950. It is not befitting in this document to enter into further details, from which you would infer that the state of our railways is far from being satisfactory. A glance at the figures which I have given suffices to confirm this unfavorable inference, and on more careful and more scrupulous examination, you would come to the conclusion that there is not a single company that takes into account its real obligations to the public, or renders the services expected by the Government at the time of the concession. The traffic of the railways could be doubled and trebled. In any case it could be considerably increased, and the tariff might be easily reduced so as to diminish the responsibility of the Exchequer. But the very limited rolling stock of the lines, the disgraceful want even in some, which seems to have brought about the defect, renders it perfectly useless for the public to complain, and the action of the Government is barren of practical results. We are utterly powerless to overcome the difficulties for the moment.

"Theoretically, the Railway Act arms the Government with power to surmount these difficulties. Practically, it is not so. The law requires that the railways should have sufficient rolling stock for the traffic. But the prescription is so vague that it can be easily eluded. The companies resist, and in the meantime traffic increases in the most extraordinary manner. In some cases there is a certain excuse, a reason for the deficiency, but there are others to which the Government must display the strictest severity. Those companies that enjoy a guarantee have certain duties to discharge, which they overlook. They should strain every nerve to increase their traffic and earnings, which after all is but an act of honesty. The neglect of these duties affords the Government sufficient ground for the withdrawal of the guarantee. I cannot find an adequate expression to qualify the conduct of those companies which collect their guarantee and pay little or no attention to traffic, which is allowed to languish and decrease. On the slightest pretext attention is called to the necessity of paying the guarantee punctually in order to maintain the credit of the country abroad, but I do not see how the credit of a country could suffer when it is proved that the State is compelled to take coercive steps against companies that have converted Government protection into a criminal and iniquitous exaction. The Argentine Government is not afraid to enforce its rights. Its credit stands firm and immovable, for we have always met our obligations.

"I call your attention to the necessity of modifying the law in reference to rolling stock. If we allow the present state of affairs to continue, millions of tons will remain in the railway stations and depots, and the Government will be compelled to pay exorbitant guarantees, which freights could amply cover. The difficulties in settling the guarantees, the necessity of rendering possible the negotiation of the concessions recently granted, suggested to the executive the idea of regulating the settlement of guarantees, in accordance with the spirit of the law. The arrangements decreed have removed all difficulties, and have been much applauded. European capitalists merely await your sanction to negotiate the concessions. Government has paid considerable sums for guarantees. The railway returns are relatively insignificant, a fact which I consider sufficient reason not to grant many guarantees, although the interest demanded has fallen from 7 and 6 per cent. to 5 per cent. The fact of our having granted several concessions without guarantee shows that the country has entered a new era. To remedy the abuses and evils which I have alluded to, the Executive recently issued a decree. A special committee is to study the state of the railways and to propose the necessary measures."

A New Method of Inserting and Securing Crank Pins.*

In this paper Mr. C. C. COLLINS explained a method which he had successfully employed for securing a crank pin, so that it could be readily removed and readjusted. The necessity of frequently altering the throw of the crank from 8 to 12 ins., or the reserve, in some experimental work led to the adoption of the device shown in the accompanying drawing, which Mr. COLLINS describes as follows:



New Method of Securing Crank Pins.

"The holes in the crank *D* were bored taper, largest at the back side. The bush *B* was also bored taper, and turned on the outside to fit the taper hole in the crank, so as to bring the edge to within about $\frac{1}{16}$ in. of the front face of the crank. In fitting this bush, the taper hole in the crank was scraped so as to insure the absolute truth of crank pin in relation to the shaft. The pin *A* was then turned and fitted to the bush *B*, so that the shoulder should be at the same distance from the edge of the bush that the face of the crank was, viz., $\frac{1}{16}$ in., this bush was then cut from end to end, so as to give it a chance to expand or contract, and it thus became a circular wedge between the crank and the pin. The end of the crank-pin is fitted into the nut *C*, care being taken that the thread is a good fit. It is better not to make the pitch of the thread too coarse. Now insert the pin *A*, and place the circular wedge *B* in at the back between the pin and crank, and force it well home by means of the nut, and you have a pin as rigid as if it had been put in by means of shrinking, or forced in by hydraulic pressure, and yet one easily removed without injury either to pin or crank.

"This particular pin was never subjected to a continuous test in running, but it showed, under a variety of trials, that it would stand up to its work without fault. I believe that this method employed on built-up double cranks would be of great utility, especially where, for any cause, crank-pins have to be removed or renewed."

*Abstract of Paper presented at Seventeenth Meeting Am. Soc. Mech. Engineers.

Coal Production of the United States in 1887.

The special agent of the U. S. Geological Survey, Mr. CHARLES A. ASHBURNER, has compiled statistics of the coal production from 1887, from which we take the following table, which shows the total production and its spot value in each State and Territory, exclusive of colliery consumption.

States and Territories.	Quantity short tons	Value at mines.
Pennsylvania—		
Anthracite	39,506,255	$79,365,244
Bituminous	30,866,602	27,896,941
Ohio	10,301,708	9,006,848
Illinois	10,278,890	11,152,593
West Virginia	4,836,820	4,591,979
Iowa	4,473,828	5,991,735
Maryland	3,278,023	3,114,122
Indiana	3,217,711	4,324,604
Missouri	3,209,916	4,298,994
Kentucky	1,933,185	2,223,163
Alabama	1,900,000	2,470,000
Tennessee	1,900,000	2,470,000
Colorado	1,791,735	3,941,817
Kansas	1,596,879	2,235,631
Wyoming	1,170,318	3,510,854
Virginia	825,263	773,360
Washington Territory	772,502	1,699,746
Indian Territory	605,911	1,286,692
New Mexico	508,034	1,524,102
Georgia	313,715	470,573
Utah	180,021	360,042
Arkansas	150,000	252,500
Texas	75,000	150,000
Michigan	71,461	107,191
California	50,000	150,000
Oregon	31,696	70,000
Dakota	21,470	32,205
Montana	10,202	35,707
Rhode Island	6,000	16,250
Nebraska	1,500	3,000
Idaho	500	2,000
Total	123,965,255	$173,530,996

The total output of the mines including colliery consumption was 129,925,557 short tons, valued at $182,461,837; the increase over 1886 being 17,182,154 tons, and $27,891,661 in total value—a very marked increase.

THE WATKINS RANGE FINDER.—The English Government has given Major WATKINS $125,000 and $5,000 a year for 10 years for the control of his position finder for guns. The inability of the human eye accurately to measure distances covered by rifled guns, has long been recognized by artillerists. Inventions to meet the difficulty have not been few, but they have never more than half filled the gap in artillery science. The WATKINS invention, however, which was first announced in 1872, has been steadily perfected until it now enables 20 guns to do the work of 220 under the old system. It triples or quadruples the power and rapidity of fire of heavy guns in forts and earthworks. It makes a good artillerist of the rawest gunner, since it reduces him largely to a machine, and increases the proportion of hits on a moving target a mile or more from shore from 20 to 80. The invention is operated in a directing station removed from a battery, and the simple laying of a telescope in this, marks on the dial in front of the gunner the exact training and elevation. Consequently an artillerist need not look out of the port, does not need to see the object, and shoots as accurately over a hill as in any other direction. One important result of the adoption of the invention, is the increased service ability of the old muzzle-loading cannon. It is proposed to fit them with the position finder and load with melinite shells, making them highly valuable up to 4,500 yards.

IT is said that of the 7,682 boilers inspected by the Hartford Steam Boiler Inspection and Insurance Company in March, 1887, 837 were found to be dangerous; there were 3,497 cases of defective riveting and 225 dangerous defects due to leakage around the tubes.

Wire Rope Fastenings.*

The difficulty experienced in getting a satisfactory fastening for use in conducting tests of wire ropes, occasioned the investigation of the subject, by MR. WM. N. HEWITT, and the preparation by him of this paper, in which the various styles of fastenings are described, and their relative merits discussed.

Two distinct types of fastenings are in use: the splice and thimble, shown in Figs. 1 and 2; and the socket, of which Fig. 3 is an example. Mr. HEWITT describes these and their various modifications as follows:

Fig. 1. Thimble Spliced in.

Two styles of splices are used. Fig. 1 shows that in which the wires, after being frayed out at the end, and the rope bent around the thimble, are laid snugly about the main portion of the rope and securely fastened by serving or wrapping with stout wire; the extreme ends which project below this wrapper being folded back, as shown at *a*. The other style Fig. 2 is by interlocking the strands in the usual manner of splicing, and also wrapping with wire as in the first method; the latter mode of fastening possessing the greater strength.

Fig. 2. Thimble Spliced in.

The socket Fig. 3 is a block with a conical hole in which the rope is secured by fraying out the wires at the end to conform in shape with the conical form of the aperture, the interstices between the wires being filled up with spikes or nails, which are driven in as tightly as possible, and the whole finally cemented with molten Babbitt metal. This is a much neater fastening than either of the preceding, but as usually made, does not possess anything like the strength.

In the first tests the specimens were secured by means of thimbles spliced in at the end, as in Fig. 2. The objection to this mode of fastening, is the thimble, which is usually made of a piece of curved metal bent around into an oval shape, as shown in Figs. 1 and 2, with the groove outside in which the rope lays, and the ends coming to-

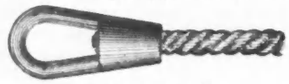


Fig. 3, Loop Socket.

gether in a sharp point at *x*. In the tests, one extremity of the thimble usually wedges itself beyond or past the other, cutting one or more of the strands, and the rope almost invariably breaks in one of the splices. This difficulty with thimbles led me to try some experiments with sockets. As this style of fastening is most generally applied in elevators and hoists of all kinds, the matter struck me as of sufficient importance to merit investi-

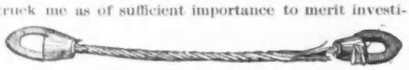


Fig. 4, Cast Steel Rope with Socket.

gation, if for no other purpose than to determine the holding power of the fastening. In every case, as predicted by Mr. N. O. OLSEN, who conducted the tests, the rope pulled out of one of the sockets under a load varying from one-half to three-fourths of the breaking load of the rope. The wires pulled out so clean from the Babbitt metal in which they were imbedded, and under such varying loads, that the defectiveness and insecurity of this mode of fastening was very apparent. It is a style of fastening so much neater than the other, however, and so much more desirable a way of securing the test specimens in order to obtain a fair test of strength of the ropes, that the matter seemed to be worthy of further experiment; and having occasion to test a cast steel rope 1½ ins. in diameter, a sample was prepared with a socket at one end of the following construction: The wires, after being frayed out at the end, were bent upon themselves in hook fashion, the prongs of some being longer than others, so that the bunch would conform as nearly as possible to the conical aperture of the socket, and the melted Babbitt metal finally run in as usual. The other end was provided with a thimble spliced in the ordinary way; the splice, however, was not made long enough, and the strands pulled out under a load of 120,330 lbs. The length of the splice was about 18 ins. The wires in the socket were unaffected.

As it was important to obtain a good test of this rope at the time, as soon as possible, and as some doubts were entertained as to the holding power of the socket, notwithstanding it withstood a load of nearly 65 net tons, the next sample was prepared with thimbles spliced in at each end; the thimbles in this case, however, being made from a solid piece of metal much heavier than usual, and circular in shape. Five strands broke in one of the splices, and the other pulled out under a load of 142,800 lbs., which was considerably below the estimated strength of the rope, indicating that the strand which had pulled out had borne no portion of the load.

*Abstract of Paper, presented at 17th Meeting Am. Soc. M. E.

The next rope tested was one of cast steel, 2 ins. in diameter, with a wire center or core. As it is difficult and unusual to splice thimbles in ropes of this size, and as the last experiment with the socket was so encouraging, the test specimen of this rope was prepared in a similar manner, as shown in Fig. 4. The wires were so coarse and stiff, however, that it was difficult to lay them snugly and compactly in the socket, and the wires pulled out of one of the sockets under a load of 228,400 lbs. About twenty of them, however, parted in the socket, the piece taken from the socket presenting the appearance shown at *c* Fig. 4.

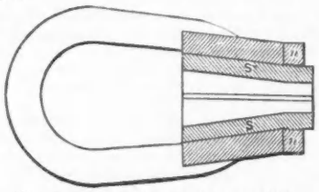


Fig. 6, Socket with Bushing and Nut.

Another specimen of the same rope was then prepared as follows: The wires were frayed out and bent over as before, with the exception of those in the core, the latter being surrounded with a narrow conical thimble or annular wedge, which was driven in tight, forcing the wire of the exterior strands firmly against the socket. The core wires were then bent over like the others, the center filled with some fine steel points, and the molten Babbitt metal finally poured in. Instead of using ordinary loop sockets, however, loop stirrups were employed, Fig. 5, which were secured in the testing machine by shackle pins 3 ins. in diameter. In this case the wires in the socket, with the Babbitt metal in which they were imbedded, pulled out about ¾ in., and the rope then broke under a load of 266,250 lbs. Fig. 5 illustrates the appearance of the specimen after fracture.

Fig. 5, Loop Stirrups.

The U of the stirrup, which was made of a bar of mild basic steel 2½ ins. diameter, was also slightly cracked at *b* on the inside of the bend, due to the fact that the bend was made too sharp and opened in coming to a seat against the shackle pin. This rope was made of the Trenton Iron Company's special cast-steel wire, and was composed of 6 strands, each 19 wires, surrounding a core also of 19 wires, the average tensile strength of the individual wires per square inch being 190,000.

Another and perhaps a better mode of attaching the socket is that shown in Fig. 6.

The socket is bored out to the desired conical form and fitted with a shell or bushing *S*, made in three pieces, and provided at the small end with a screw thread. The wires at the ends of the rope are frayed out, but not to such an extent as in the preceding case, and bent back against the body of the rope, some of the prongs being longer than others in order to produce the desired conical bunch or head, which, surrounded by the shell *S*, is inserted in the socket; the construction being such that the threaded portion of the shell projects below the socket sufficiently to accommodate a nut *n*, by which the shell is drawn tightly into the socket, thus firmly clamping the wires. Molten Babbitt metal can finally be poured in, if necessary.

A socket which meets with much favor in Great Britain is illustrated in Fig. 7.

The sockets are forged in one piece, the eye being afterward bent in. The rope to be socketed is first served with annealed wire from the point *a* to the point *b* (Fig. 8). The rings *c*, *c'*, *c''* are slipped up over the rope in their respective order, followed by the conical-shaped block *d*. The rope is then frayed out from the end of the serving, and the wire ends are so trimmed in layers that when they are bent over the block cone *d* they will lie smoothly and regularly on its outside surface. The eye of the socket-forging is heated red-hot and bent over the rope and closed on an anvil. The rings *c*, *c'*, *c''* are then driven home to their respective places. To prevent the slipping of the rings, the metal of the socket is generally upset against them with a cold chisel. For still further security, the socket is then poured full of Babbitt metal the usual way.

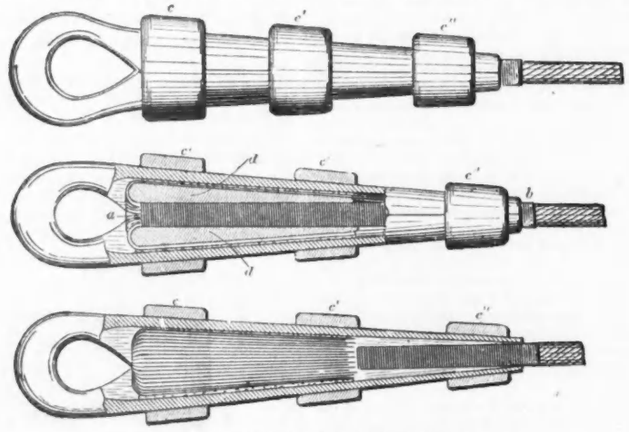


Fig. 7.—Socket used in Great Britain.

An improvement on the preceding socket is to cut a thread on the lower end of this socket and force the rings up to, and maintain them in their respective positions by a nut which would close the small end of the socket; a light gas-pipe sleeve being fitted between each ring.

In closing, Mr. HEWITT submitted the above table containing the data of a few of the first tests made, and regretted that a more systematic record had not been kept. Such a record would certainly be of very great interest.

Diameter in inches.	Kind of Material.	Kind of Fastening.	Breaking load in lbs.	Where Fractured.
1	Cast steel.	Socket.	27,430	Pulled out of socket.
1	" "	Thimble spliced in.	58,000	Broke in top splice and cut one strand at bottom.
⅞	Swedish iron.	" "	22,430	At bottom thimble.
⅞	" "	" "	22,390	At top thimble.
¾	" "	" "	21,670	At bottom thimble.
¾	" "	" "	19,450	Cut at top thimble.
¾	Cast steel.	" "	28,870	One strand broke in several places.
¾	" "	Socket.	23,140	Pulled out of socket.
⅝	" "	"	14,200	Pulled out of socket.
⅝	" "	Thimble spliced in.	21,900	Two strands broke in splice.
⅝	Swedish iron.	"	12,730	In the body of the rope.
⅝	" "	" "	14,060	In the body of the rope.
½	Cast steel.	" "	12,930	Broke a 1-in. pin before rupture; gave way in two strands.
½	" "	Socket.	8,850	Pulled out of socket.

Horse Power of Marine Engines.

The purposes of Lloyd's and other shipping registries have emphasized in recent years, the pressing need of some rule or formula easy of application for finding approximately the horse power of marine engines, the results to be sufficiently accurate to furnish an adequate standard for determining the relative commercial values of the different machines.

The ambiguity of the term "Nominal Horse-Power" and the efforts made to attach a definite meaning to it were discussed in our issue of June 30. We now notice briefly the most recent attempt to clear the matter up, which was made by the North-east Coast Institution of Engineers and Shipbuilders, of Great Britain, by whom a formula which seems to meet the requirements of simplicity and accuracy has been developed and reported to the various engineering societies for their consideration.

Four variable factors are taken into account, two dependent upon the engine and two upon the boiler. In all other respects the engines are assumed to be working under normal conditions, which are the following:

(1) The steam is always expanded down to the same pressure; (2) the expansion is effected with the same efficiency at all pressures; (3) the piston speed varies as the cube root of the stroke; (4) the boilers are constructed according to fair average practice; (5) the efficiency of the mechanism is constant.

It was found empirically that the mean steam pressure reduced to low pressure cylinder is very nearly equal to 5.6 times the cube root of the initial pressure; that in actual working the piston speed is about equal to 144 times the cube root of the stroke in inches, and that, approximately, the power of the boiler is equal to the heating surface, multiplied by the cube root of the pressure per square inch, and divided by 16.

Assuming that the conditions enumerated hold good, the following expression for *normal* indicated horse power is deduced:

$$N.\ I.\ H.\ P. = \frac{(D^2\ \sqrt[3]{S} + 3\ H)\ \sqrt[3]{P}}{100}$$

D = diameter of low-pressure cylinder in inches. If there be more than one low-pressure cylinder, D^2 = sum of the squares of the diameters.
S = stroke of piston in inches.
H = heating surface of boilers in square feet.
P = working boiler pressure in pounds per square inch.

In deriving the above expression it is assumed that the power of the engines and boilers, taken as one complete machine, will be equal to half the sum of the separate powers of the engines and boilers; though, when properly proportioned, the boiler and engine should have the same horse power. The various steps in the deduction of this formula are simple and need not be enumerated; the denominator in the final result is 104, for which the more convenient number 100 has been substituted, the error being inconsiderable.

For paddle engines the rule is altered by substituting for the 3 in the numerator a 5, and for the 100 in the denominator, 60. The power of marine machinery, as thus ascertained, has some real scientific and commercial value; but if users desire a number that shall compare more nearly with the old nominal power, they may divide the above result by 6, thus:

$$\text{Nominal horse power} = \frac{N.\ I.\ H.\ P.}{6}$$

Of course this is only an approximation to the nominal horse power.

A LIVELY BOARD OF ALDERMEN.—We cannot refrain from clipping the following spicy local item from one of our exchanges:

"The municipal menagerie held a session last night. Only two of the alderman were drunk. Some items of business were got through by the monumental patience of the Mayor, during the interval when he was not pounding the desk in a vain effort to keep order. That he did not have the two aldermen locked up was due to his goodness of heart and his chronic failure to take advantage of a good thing when its face is turned toward him."

THE daily consumption of needles in this country is said to be 4,200,000, of which a very large proportion come from Redditch, England.

CORRESPONDENCE.

Destructive Force of Colliding Trains.

SCRANTON, Pa., July 26, 1888.

EDITOR ENGINEERING NEWS:

If the position you took some months ago in regard to the destructive force of colliding trains be correctly quoted by Mr. GILMAN, in your issue of July 14, I think your conclusion is wrong.

In Mr. GILMAN'S communication he says: "Your position was that if two trains of equal weights collide, with velocities of 30 miles per hour, the crushing and breaking would be only one-half as great as it would be if one train was at rest while the other was moving at the rate of 60 miles per hour."

I am unable to see how you arrive at this conclusion. The two trains of equal weight are approaching each other with a relative velocity of 60 miles an hour, and when they meet they stop, after entering into each other a certain distance. The longer they take in stopping, the better for those in the rear cars. Now, in what does this differ from one train going at 60 miles per hour and running into another standing still? As to one climbing up upon the other, that would depend, it appears to me, upon the shape of the parts first coming into contact, or upon some accidental circumstances which should deflect one or the other upward or sideways.

I do not know that I should have ventured to ask space merely to express a difference of opinion, but in looking up the matter I chanced to detect an error in a place where I did not expect to find it, viz:—CLAUDEL'S AIDE-MERRIONE, (9th edition 1877). I do not know if this error is to be found in other similar works—if it is general, its existence should be known: that is supposing I am right in considering it to be an error. It will be necessary, in order to make the point plain, to very briefly run through the theory of shocks, as follows:

When two non-elastic bodies of mass m and m', moving at velocities respectively of v and v' and, therefore, possessing the momenta mv and $m'v'$, come into contact upon the same trajectory, they unite in forming a joint mass equal to $m+m'$, actuated by a common velocity u, and possessing a momentum equal to the algebraic sum of the original mementa previous to the shock. We have therefore:

$$(m+m')\ u = m\ v \pm m'\ v'$$

whence,

$$u = \frac{m\ v \pm m'\ v'}{m+m'} \qquad (a)$$

The double sign represents the two cases of the bodies moving in the same or in opposite directions, and the joint mass continues to move in the direction of the mass originally possessing the greater momentum. If the two momenta are equal and of opposite signs, the resultant velocity equals zero, and the joint mass remains at rest.

If one of the bodies, m' for instance, is at rest, when the shock occurs, $v'=o$, and we have

$$u = \frac{m\ v}{m+m'} \qquad (b)$$

The destructive force of a collision consists of the destruction of vis viva which it occasions.

When two such bodies as those designated above come into contact when proceeding in opposite directions, one or the other of them, m' for instance, is considered as being at rest, and the other as coming into contact with it with a velocity $V = v+v$. (I am here giving the accepted theory, which, I understand that ENGINEERING NEWS takes exception to.) After the shock they proceed (theoretically) in the direction of the moving mass, with the common velocity u.

The loss of vis viva is therefore equal to:—

$$\frac{1}{2}.\ m\ V^2 - \frac{1}{2}.\ (m+m')\ u^2$$

Now it is at this point that occurs the presumed mistake in the AIDE MÉMOIRE to which I desire to call attention: In solving the above equation CLAUDEL substitutes the value of u from equation (b) giving the loss of vis viva equal to:—

$$\frac{1}{2}.\ \frac{m\ m^1\ V^2}{m+m^1} \qquad (c)$$

It is quite clear I think, that the value of u which should be taken in this case, is that given in equation (a). For, supposing the bodies to possess equal masses and equal velocities previous to the collision, they would, as we have seen, come to a stop, whereas equation (b) would give a resultant velocity $u = \frac{V}{2}$; that is, the two bodies would go on, after the collision, with a velocity equal to that which each possessed before contact. If I am correct in this view, equation (c) should be written:—

$$\frac{1}{2}.\ m\ V^2 - \frac{1}{2}.\ \frac{m^2\ v^2 + m'^2\ v'^2 \pm 2\ m\ m'\ v\ v'}{m+m'}$$

This error belongs to a probably numerous class, and arises from following, beyond its legitimate scope, an *as if* hypothesis. That is, in this case, the *actual shock* takes place *as if* one body were stationary and the other moving with the total relative velocity; but the subsequent velocity, (or no velocity) of the joint mass must be determined by the *actual facts*, and for this purpose we should use the original formula (a), which is always right, and of which (b) is only a special case.

In the above I have taken the *masses* of the bodies instead of their *weights*: it is needless to remind your readers that mass equals weight divided by 32.2.

As you point out in commenting upon the communication which I have referred to, in railroad practice the colliding bodies do not join forces after coming into contact and proceed on their way in the direction of the more *momentous* train, unless the relative velocity of approach be slight, as in coupling cars; on the contrary, there must be a second destruction of live force when those portions of the two trains which try to go on, are brought to a stop.

G.

[On the return of our "Collision Editor" from his vacation we may have something more to say upon this subject; but in the meanwhile we give our readers the benefit of our correspondent's observations.—ED. ENG. NEWS.]

Rock Fill Dams.

PORT JERVIS, N. Y., July 29, 1888.

EDITOR ENGINEERING NEWS:

The article on "Rock Dams" in ENGINEERING NEWS of July 28, contains the following reference to the rock fill and culvert at Cascade, N. Y., South-east and West R. R.: "This culvert tunnel has continued ever since to discharge all the water of the gorge, the rock-fill being practically tight."

The culvert is 50 ft. above the foot of the embankment on the up stream side, and only after very heavy rains (say 3 or 4 times a year) does any water pass through it. The ordinary drainage from the gorge passes through the fill. It, therefore, seems that the "era of usefullness" of this rock-fill as a waterway (reinforced by the culvert for unusual flow) is not yet entirely ended, and the idea of the Superintendent in making the fill not deserving of such condemnation as is given it in your columns.

E. T REISLER, C. E.

[From our correspondent's letter it would appear that the embankment must form a dam and raise the water about 50 ft. before the culvert comes into play. That it does this even "3 or 4 times a year" shows that the rock-fill is "practically tight", so far as serving the purpose of a culvert is concerned, especially in quickly removing storm-water.—ED. ENG. NEWS].

Protecting Pipe from Freezing.

TAUNTON, Mass., July 30, 1888.

EDITOR ENGINEERING NEWS:

Can any of your readers tell me from experience of a packing which can be *relied upon*, to keep from freezing, in all weather, a 4-in. pipe exposed under two short bridges, width 10 or 12 ft. each, under a system of direct pumping; domestic pressure 55 lbs.; fire pressure, 100? We can bury the pipe in the bed of the stream or keep a small tap running in cold weather. If possible we would like to find a better way than either.

G. F. C.

THE canal to be cut across the isthmus of Perekop from the Black Sea to the Sea of Azov is to be 70 miles long, 65 ft. wide, 12 ft. deep, and will reduce the voyage from Odessa to Marinpal, from 434 to 295 nautical miles. The work will be done by a French company and its estimated cost is $40,000,000, most of which sum is said to have already been secured.

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Coming Technical Meetings.

Civil Engineers' Society, St. Paul, Minn. — Regular meeting, Aug. 6. Secy., G. L. Wilson, City Hall.

New England Roadmasters' Association. — The 6th annual meeting will be held at Boston, Mass., August 15, 16. Secy.; W. F. Ellis, Roadmaster, Providence & Worcester R. R. Woonsocket, R. I.

American Association for the Advancement of Science. The thirty-seventh meeting will be held at Cleveland, O., from August 15 to August 21, 1888. The headquarters will be at the Hollenden. For particulars address F. W. PUTNAM, Salem, Mass.

Engineers' Society of Western Pennsylvania, Pittsburg, Pa.—Regular meeting, Aug. 21. Secy., S. M. Wickersham, Penn Building.

Engineers' Club of Kansas City, Mo.—Regular meeting, Sept. 3. Secy., Kenneth Allen, 19 Deardorff Building.

American Society of Civil Engineers, New York.—Regular meeting, Sept. 5. Secy., John Bogart, 127 E. 23d St.

Roadmasters' Association of America.—Next meeting at Washington, D. C., Sept. 11. Secy., H. W. Reid, Waycross, Ga.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting, Sept. 19. "House Drainage". Secy., S. E. Tinkham, City Hall.

Association of North American Railroad Superintendents.—Next meeting at the Southern hotel, St. Louis, Mo., beginning Sept. 19. Secy., Waterman Stone, Providence, R. I.

Engineers' Club, Philadelphia, Pa.—Regular meeting Oct. 6. Secy., Howard Murphy, 1122 Girard St.

American Society of Mechanical Engineers.—Convention and annual meeting at Scranton, Pa.; beginning Oct. 15 Secy., F. R. Hutton, 280 Broadway, New York.

THE New Croton Aqueduct Commission as appointed by Mayor HEWITT seems to be an unexceptional one. It is made up of men of very excellent repute, selected for their general knowledge in connection with the work to be done. The engineer representative is a particularly able man, with a brilliant and most honorable record, professionally and personally. But we must express some disappointment in not seeing in that place some one of several civil engineers nearer home who have made a more intimate study of the Croton Aqueduct generally and the Quaker Bridge Dam in particular. However, as the Mayor has very properly seen fit to carefully exclude from this position gentlemen of other professions who stand committed in any manner on this very important question of the dam, it was perhaps just as well to extend the same embargo to members of the engineering profession. With this view of the case no better appointment, or one more satisfactory to engineers and laymen, could have been made than that recorded.

In this connection we are pleased to note that Messrs. O. B. POTTER and WM. WEBB had the public spirit and good common sense to decline appointment on the new Commission, if it was offered to them as implied in a reported interview with Mayor HEWITT. With their pronounced public expression of opinion *against* the Quaker Bridge Dam, the service of these gentlemen as judges upon the expediency and design of so important a public work would have been peculiarly embarrassing to them and perhaps unfortunate to the public. With the best intentions in the world and in the light of any amount of testimony tending to prove that previously conceived ideas were founded in error, it would be difficult for a judge, prejudiced in advance either for or against any particular case, to properly perform the functions of his high office. The case of the engineer is radically different; for his convictions are founded upon technical research and experience within the bounds of his own particular profession. His opinions are his own, and not those based upon the more or less honest and intelligent report of other men who rarely have all the data at hand necessary for a sound and proper conclusion. Previous intimate knowledge as an engineer of all the details of a great work only tend to make that engineer a better judge, just as the occupant of the judicial bench proper is only fitted for his position by the most thorough acquaintance with legal intricacies. But as the Mayor has so well applied his rule of exclusion in the one direction and that of professional selection in the other, we can only congratulate him on his general wisdom, and the people of New York on the possession of an honest, intelligent and altogether good Commission. Now let them go to work, and among the first things done pass the plans and commence construction on the Quaker Bridge Dam. The aqueduct is fast approaching completion; and, notwithstanding the contrary opinion of would-be but inexperienced judges, this aqueduct without the dam would be equivalent to Hamlet with the part of the princely Dane omitted.

LAST Tuesday was the 85th birthday of JOHN ERICSSON, a man whose name must be forever most honorably associated with the great engineering advance of this century, the greatest progress, when measured in a period of years, that the history of the world records. Since 1826, at the very beginning of the railroad era and all that that term means, Mr. ERICSSON has been identified with the mechanical triumphs of our times. His record is a proud one. Steam engines; early locomotives; the first successful application of the screw propeller to steamships; the *Monitor*, with its revolving turrets; the direct use of the sun's rays as a motor, are only a few of the greater among his many inventions for the good of man. And he is yet, notwithstanding his age, a man of vigorous mind, fully capable of reviewing, with the pleasure that only a veteran can know, the battles fought and won in the period of this one life, battles in which the world's progress was the stake. May he see yet other birthdays, and again and again receive the congratulations due him as a man and an engineer.

IF the bill recently passed by the House of Representatives providing for the eleventh and subsequent censuses becomes a law, as in all probability it will, the number of subjects investigated in future will be reduced to seven. These are population and social statistics relating thereto, manufactures, mining, agriculture, mortality and vital statistics, valuation and public indebtedness. The statistics which swelled the publications of the last census to 22 large volumes are not limited to the precise period at which the census is taken, but are of continuing importance. They are omitted because the information can be more readily and satisfactorily gathered by other Government bureaus. On this account the number of volumes printed will probably be only seven, and they may be expected to appear more promptly than formerly.

THE proceedings of a late meeting of the Halifax, N. S., City Councils, as reported in the *Acadian Recorder* of that city, prove that cases wherein the authorities disgrace the city they misrepresent are not peculiar to some well-known examples on this side of the line. At this particular meeting business was commenced by charges and countercharges of "fixing" among some of the members in connection with a proposed public improvement; and this affair was only laid aside to discuss a "late drunk" of one of the committees and to dispute over the bill for Scotch whiskey, etc., then consumed and charged for to the City under the innocent head of "labor". But the feature in which engineers are most concerned is the disagreeable position held under such masters by the City Engineer of Halifax, Mr. E. H. KEATING, a Member Institution Civil Engineers and of the American Society of Civil Engineers, and a gentleman well and favorably known to many of his profession in the United States. In some piece of city work Mr. KEATING apparently offset the contractors' claim by a claim of the city; but was rewarded for his interest in the city's affairs by a resolution passing the original claim intact and the statement that his report on the subject was "a lying and dishonest one"; and he was further practically informed that he must not dare, on pain of dismissal, to report adversely upon any scheme backed by members of the Council. Later in the session a letter was received from Mr. KEATING referring to the action of the Councils in practically giving each ward commissioner sole control over work in his ward without reference to the city engineer, and yet holding the latter official answerable for such work under the general law. Mr. KEATING points out the lack of system existing in the control of city work and suggests amendment; but he was reminded by the aldermen that "it was not the engineer's place to lecture the Council", etc.

MR. KEATING will have the sympathy of quite a number of city engineers on this side of the line in his disagreeable battle with officials who neither grace nor govern the cities they represent. He and the others referred to can console themselves, however, with the thought that to be denounced by men of such calibre is rather a compliment to personal integrity than otherwise. The Halifax experience in its present board of Councilmen is only another illustration of the too frequent case where the source of all local power is seized upon by a class of men that no honest citizen would for a moment intrust with his private business. That such things are possible every city of sufficient importance to warrant "plunder" knows too well. But while there is something radically out of joint in our present methods of municipal government, we can expect little improvement until the "honest citizen" becomes sufficiently old fashioned to again sacrifice some personal comfort, and perhaps gains, in the public interest of the community of which he forms a part. This was the practice of his fathers in the day when it

was a high local honor to be an Alderman of the City of New York, for example; and until this position again becomes honorable we must rest content with the misrule of men who make politics a profession and hold public office for private gain, more or less honestly acquired.

WE have only received $5.00 this week for the Kutter fund; from Mr. GUSTAV LEHLBACH. This contribution, together with $5.00 from Mr. E. B. GUTHRIE not previously acknowledged, makes a total of $855, which has been forwarded to Mrs. KUTTER this week. Until this lady can by letter or otherwise express her appreciation of the kind action and thoughtfulness of American engineers in her necessity, the deed must carry its own reward. We still wish that the full $1000 may be made up, as it is now so near the mark; but rejoice at the generous nature of the fund already raised upon the simple notification that the widow of a worthy brother engineer was in distress.

As we go to press we receive for the Kutter fund the following third contribution from members of the German-American Technical Society of New York:

Mr. Knauer	$5.00	
Mr. des Ondes	2.00	
A. Siebert	2.00	
E. Friedmann	2.00	
A. Droegmundt	2.00	13.00
Previously acknowledged		855.00
Total to date		$868.00

Who Should Pay for the Abolition of Grade Crossings on Railways?

Last week the Governor of Massachusetts, in accordance with a legislative act passed May 29, 1888, appointed Messrs. A. W. LOCKE, WM. O. WEBER and GEORGE A. KIMBALL as a committee of three competent and experienced civil engineers, to investigate and report upon the gradual abolition of grade crossings on the railways of that State. This committee is to report before Feb. 1, 1889; is not to expend more than $10,000 in its investigations in total, and is to include in its report suggestions as to the best methods of accomplishing the desired results, and of apportioning the costs and payments to be made on account of such improvements.

This is a very broad programme for the time and expenditure allowed. In the question of methods alone, each individual case of any importance will practically have its own solution; and as few will be alike in conditions it will puzzle the committee to formulate any general rule or even to suggest methods. Boston alone contains more than one intricate problem of this kind that would consume all the permitted time and money in its solution. What we suppose the committee will do, and this would be good work, is to examine into the too few cases where the attempt is being made to push this problem towards a well digested and proper solution, and to gather statistics relating to the subject. Even for this amount of committee work more time should be given.

Grade crossings are an inheritance from a generation working in a novel field and for the needs of a day now past. Our fathers built railroads far ahead of present civilization and little dreamed that their work would so soon and to such a phenomenal extent develop the sections they sought only to connect by an iron way. They had no occasion to follow the laws laid down in England, for example, where partly owing to a dense population and partly owing to sheer ignorence of the capabilities of the new power, certain rules were early formulated regarding road crossings, radii of curves and gradients. The early American engineers deserve credit rather than censure for ignoring Old World precedents and planning in accordance with their own necessities, their comparative poverty and the real end in view—the rapid and cheap development of a new country. And their faithful work accomplished its purpose far in advance of the date set by the most sanguine among the early railway promoters, and as we, in less than half a century, are reaping the vast benefits, arising from our railways, we can well afford to pay for the sins of omission, in even the near past, that now compel us to rebuild some parts of the improvements that above all things have made us great.

In fact, no one now doubts the advisability of doing the work that is referred to in this official action of Massachusetts and other States; the only question is: How shall it be done, and who shall pay for it? Owing to the enormous present mileage of our railways, the many conditions of local topography and the rapid growth and enlargement of villages into towns, and towns into great cities, this is a question with many corners, and its proper solution will cost some one vast sums of money. The just apportionment of this cost among the several parties interested in removing grade crossings is a delicate question to handle, and one fruitful of litigation and endless dispute, if the experience of Connecticut can be taken as an example.

We will not pretend, in the space of a single article or in the light of the scanty data now available, to say just how this important question and the real key to the whole situation should be decided. But it is a thing that cannot be too broadly discussed at a time when more than one State is struggling with the intricacies involved.

One of the first points to be considered is the effect of a grade crossing on a railway upon the different parties interested. First, in every large town or city it means to the railway company either an advisable or compulsory reduction of speed and a loss in time and useful effect. It means the risk, at any crossing, of meeting an obstruction that may derail the train, and will certainly entail loss of life or property on some one, for which the company will very probably have to pay. In winter every grade crossing is a menace to the train from the packing of snow or ice in the space between the rails and the roadway sills, and trains are not infrequently derailed from this cause. Gates and flagmen at grade-crossings are a permanent outlay of about an average of $500 per year, a figure that would often represent good interest on the amount required to raise the grade; and these guards do not always prevent accidents at such points for out of 47 casualties at grade-crossings of highways reported by the Massachusetts Railroad Commissioners for 1887, 17 were at "protected" crossings. These are at least a few of the reasons why railway corporations should be and doubtless are willing to contribute liberally toward the abolition of this element of danger and unnecessary expenditure in maintenance.

To the inhabitant of the city or town, or to the farmer who has occasion to cross the tracks, a grade crossing means danger, even if it be protected by gates, guards or a reduction in train speed. As before stated these precautions do not always protect, and the daily press is filled with accounts of such accidents, more or less serious; and while statistics fail to give total casualties the aggregate must be great. In this case the public safety is involved and the whole community, in cities and out of them for that matter, is interested in the removal of the danger and should bear their proportionate cost of such removals. The effect of raising or depressing tracks, upon adjoining property, is a matter purely local and the merits of each case should decide whether such change is a damage or a benefit to the adjacent property holder. In a city like Boston, where very extensive and radical changes may be necessary and of great cost, this adjustment of rights may assume formidable proportions; but while doubtless troublesome, there is a general even-handed law which applies to such cases, as in any other city improvement; the only really formidable question is that of cost and who shall meet it.

Every one who uses the railways is also deeply interested in the removal of an ever threatening danger; for while accidents to the train chargeable to a highway grade crossing may be rare, they do occur, and no one knows when and where such events are to happen, and whether or not he or his family may be involved therein. Safety in public travel is every man's interest in a country like ours where everyone travels by rail to an extent almost unknown in other countries. And to insure further personal safety every resident of a State should be willing to contribute his mite towards the improvement of the iron highways of that State

It would thus appear that not only the railways and the towns they traverse, but every traveler on the railways, and thus every resident of the State, has a more or less direct personal interest in the removal of grade crossings. And as the present agitation for better methods does not originate with the railway corporations, but rather from the whole people of the State as travelers on railways and residents along the line, it would seem proper for the State to take a more direct interest in the matter than now seems to be generally contemplated. It is the duty of the State to care for the public safety of its people; and instead of simply passing legislative enactments denouncing grade crossings as a nuisance and practically leaving the solution of the expensive puzzle to be fought over by individual railways and towns affected, it would be a shorter way out of the tangle to make the removal of such crossings a State work, paid for by a general tax and carried out under State supervision. This is simply a suggestion founded upon what seems just. But it certainly has advantages, and as the interest in the work is a very general one there seems to be thin justice in localizing the cost of a public benefit. The rate of the State tax can be fixed so as to very nearly meet the relative interest in the affair, of railways, large and small towns and the people at large, and just as at one time the States assumed the cost of building new railways so they could now improve existing roads. The adjustment of such a tax might present difficulties in its detail; but the whole problem is a complex one and this plan would seem to be no more troublesome of adjustment than the attempts of Connecticut law in the case, for example; and it should be more speedy, satisfactory and certain in its results, as saving among other things the time and money now wasted in litigation. One of the chief sources of trouble now is that many existing cases of grade crossing correction are enormously expensive, and the city and railroads directly connected therewith will both shrink from the expenditure and put off the evil day as long as possible if they alone must foot the bills. With their own tax rate reduced and a generous contribution from a general fund added there would be little cause for delay in the matter and the whole public would be the gainers by the more speedy suppression of a dangerous public nuisance.

The Control of Civil Public Works.

The arguments in favor of the bill proposing the establishment of a civil bureau of harbors and waterways, as elsewhere abstracted, make a strong presentation of the case, and the objections to such a bill are generally well met. While we have personally taken no very active part in this discussion, we must credit the promoters of this reform with a most persistent, intelligent and self-sacrificing labor in advancing this interest that is deserving of success. From personal knowledge of a number of these gentlemen we believe that their suggestions are the outcome of an honest effort to introduce better system in a direction where practice founded on tradition ceases to meet the requirements of the present time, and where the annual trading, log-rolling and pushing of private interests at public expense has the effect of delaying or even preventing the execution of work of great public necessity and usefulness.

But to be frank with the men who are pushing this bill there is an impression abroad that while it doubtless does the majority of them a gross injustice yet has the effect of weakening the force of their arguments and may defeat their present purpose. This is the feeling among many that this bill is not so much a proposed national benefit as it is a personal war between civilian and military engineers; a battle between these bodies for the control of the public works of this country. This is an unfortunate impression and one that also does injustice to the public spirit of civil engineers as a class, whether they were graduated from West Point or schools more specially teaching the profession of civil engineering. There may be some narrow-minded men in both classes who take this view of the case; but we are happy in regarding them as very few in number.

In the early days of engineering in the United States, West Point was the only engineering school within our boundaries and it supplied many of the men who designed and constructed our earlier public works, men whose names are honored among engineers. But as the demand for trained engineers soon exceeded the limited supply from this Government school, other institutions sprang up that devoted the whole course of study to engineering and the profession is now mainly recruited from the graduates of the private schools.

The engineering works of a civil character were early put into the hands of the military engineers because they were then the only men competent to control them. But these works have multiplied to such an extent and demand so much engineering service that the Government engineers are now compelled to reinforce their body with assistants from civil life, to the extent, in 1885, of 70 military engineers to 643 civilian employés of all grades. It has long ago ceased to be a position monopolized by military engineers in all responsible places requiring any engineering experience. The only difference is that as at present organized, the civilian employé, no matter how good an engineer or how valuable his personal and professional services may be to his Government, can never hope to reach the topmost rounds in a particular profession to which he devotes his useful life. This is unfair and discouraging to any ambitious spirit, and is not calculated to secure and retain for the Government the ablest engineering talent in all branches of the service, as the importance of the expenditure of many millions of public money annually demands.

We have the greatest respect for military engineers, for they include in their ranks many of the ablest engineers in our country. But we do believe, in the interest of engineering as a profession, that the time warrants a reorganization of our present system of conducting public works; in their inception and passage through Congress, and in their control under construction. Personally, we have no objections whatever to such work remaining in the present control, and see some advantages in it; the term military engineer is very generally merely a name, and does not apply at all when the work in hand has nothing of a military character about it.

But common fairness should break down all class distinction, and put all engineers, properly so-called, or even engineering students, upon a justly conceived rank basis. The midshipman in the navy hopes to be an admiral some day, and this is his guiding thought in every action that may tend to push him forward; so the youngest engineer in Government employ should have the same chance, as he would have under civil corporations, and feel that when he fully merited the position the highest professional rank is open to him.

If the present high standard of personal integrity is deemed to be in danger from outside influence, and that a government training is necessary for the maintenance of the existing *esprit de corps*, let the Government widen the doors of its engineering school, and train its own engineers as foreign nations do theirs. But do not make fish of one man and flesh of another. The Cullom-Breckinridge bill opens the door to this service to all engineers, under certain conditions of examination for fitness. But if foreign experience teaches that it is best to train our own engineers intended to practice in one particular profession, we do not see why the scheme would not be equally good here. The Government could, under the proposed bill, use only a limited number of men in its engineering work; and practically the field to be covered is the same, whether the engineer graduates from a Government school, or is made to pass a Government examination. In any such re-organization the engineers first occupying the new positions would necessarily be recruited from the civilian ranks, simply because the military class, aside from its more legitimate work, could not meet the demand. But when the new corps was once started the material for continuing it would come from the people in both cases: from the young men who propose to make a life work of this Government service.

It is not necessary to make such a government engineering school a practically free institution. It should be thoroughly equipped by the Nation in all its features of the ablest teachers and the best attainable methods; but some tuition fee, not too great to exclude the poor man's son, might well be charged. The entrance to the school should be by open competitive examination and not by mere Congressional favor, so that every deserving young men can have a chance to succeed therein if he has within him material sufficiently promising. West Point now has an engineering course, and its highest graduates and best men become engineers. But this course is hampered with sundry other lines of instruction that have no value whatever to the man who is to control our civil public works, and the time devoted to them could be much better expended in widening the field of purely engineering research, and more fully acquiring that knowledge which he is to practice at the expense of a nation.

A certain amount of military discipline will be well and proper and impart a spirit that will be useful to any young man in after life; but it should be very subordinate to the main end of making a thoroughly trained civil engineer. The examination should be as rigid as any in the present military course, and the dead-wood eliminated by strict selection; but let the graduate be all an engineer, and not half engineer and half soldier. This change in training and the recruiting of a force more equal to the work in hand, would, in our opinion, meet all the present requirements, with or without a change in the name of the controlling body.

The Springfield Stone Arch.

In the *Springfield Republican*, of July 31, Mr. E. C. GARDNER, an architect of excellent repute, has considerable to say upon the Springfield stone arch question; and in general he says it very well. But while we fully agree with some of his criticisms upon the three plans presented, and given to our readers, there are other points upon which we must disagree. Mr. GARDNER classes the Boston design as "a beautiful stone bridge," which would probably be in better keeping, spaning a rocky chasm or a water course. In the proposed location over a street, however, he believes this bridge to be too unmistakably a railroad bridge; asserting itself to an obnoxious degree and saying to the citizens—"I have a right-of-way across Main Street and propose to take it. I will lift a portion of my back like a huge serpent and you may crawl under my belly if you like; but, observe, I am still the railroad."

It is just this hump in the serpent's back that we objected to, Mr. GARDNER, and it is the somewhat concentric curves of arch opening and parapet that suggest the serpent simile and unpleasantly impress the looker-on; particularly when this upper curve sinks into a horizontal plane on either side, a break in the "sky-line" which is very unserpentine.

And this brings us to Mr. GARDNER's further criticism upon the crenelated parapets of Mr. HERSCHEL's designs. The point is made that this architectural feature is effective "as breaking the sky-lines" on a lofty wall or tower, but that in the case of this structure, of about one-third the height of adjoining buildings, the sky-line is not of much consequence. Mr. GARDNER admits too much for the strength of his own argument; and a glance at either of Mr. HERSCHEL's designs, as published in the *Republican*, will, we think, convince him that when you are looking up or down a wide street from any point near enough to criticise the bridge, sky-lines are of some consequence, even on a structure no higher than this bridge; in fact of more consequence than if the top was so lofty as rarely to be seen except at a very considerable distance.

The objection is also made that in design "*A*", of Mr. HERSCHEL—"the six minor granite arches carried in a precarious looking fashion upon the haunches of one broad one, seem to involve an amount of labor for which there is no adequate compensation." This objection has a precarious footing in the purely imaginary lack of footing in the secondary arches. But to the engineer, whatever it may do to others, this very design tells the story of its purpose and goes at that purpose more directly than anyone of the plans presented. The main arch spans the space and in its proportions does the heavy work; the secondary arches carry the parapets, and more important still the railroad, which is the real intention of the bridge and which demands a nearly horizontal plane. If the architect conceals these arches by a face or merely ornamental wall, the engineer knows that they must either be there, or that their place is less effectively occupied by unnecessary masonry or haunch-filling of some kind. These secondary arches are expensive, but they have a purpose.

We fully agree with Mr. GARDNER's criticism on the segmental arch design, springing from the ground-line, and have already commented upon the waste-space at the sides. But Mr. HERSCHEL also recognizes this breach of grace and utility, and summits a design "*B*" which very effectively removes this disadvantage, and by decreasing the spandrel area he eliminates altogether the secondary arch feature objected to.

The objection made to the flatness of the arch in design "*B*", that it is a painful strain upon the masonry and gives rise to some apprehension of disaster, is the soundest objection in the letter in question. But the real danger lies in bad material and poor workmanship rather than in the design. It is a bold arch, and of a type that would demand some considerable technical skill in its design and execution; but it can be safely built, and should cost no more than the other arches, for it reduces the nominal span and yet retains all of the effective clearance under the arch. To break this span into roadway and footway arches would doubtless give the laymen the desired appearance of greater safety; but it would probably also cost more money in its effective treatment. An elliptical arch might possess some advantages over either form in point of cost and grace combined.

As MR. GARDNER is undoubtedly a good architect and has generally sound views upon the subject, it would seem that in the interest of good taste in his native town, he should either submit a better plan, or acknowledge the merits of some one of those already presented.

PERSONAL.

COLGATE HOYT, of New York, has resigned his position as Director of the Union Pacific Railroad.

H. E. WESTERMANN, a civil engineer on the Mobile & Ohio R. R., died recently at Belleville, Ill., at the age of 30.

JOHN K. AKERMAN, of Biddeford, Me., has been appointed Superintendent of the Biddeford & Saco Street Ry.

Maj. J. F. O'BRIEN, Superintendent of the Mahoning division of the New York, Pennsylvania & Ohio Railroad, has resigned.

J. D. COOK, C. E. of Toledo, O., will probably be Consulting Engineer of the water-works at Houston, Tex.

E. M. COLLINS, of Kirksville, Mo., has been appointed Chief Engineer of the St. Louis & Northwestern R. R., and will start the surveys at once.

Gen. J. G. SHALER, General Superintendent of the New York, Pennsylvania & Ohio R. R., has resigned, and the position is abolished. The duties of the office will be undertaken by E. B. THOMAS, 2nd Vice President of the New York, Lake Erie & Western R. R.

E. O. VANDEVANTER has resigned his position as engineer for Brown, Howard & Co., on the new Croton Aqueduct, to accept the position of Division Engineer on the Baltimore & Harrisburg Division of the Western Maryland R. R.

S. P. MAWRY, City Engineer of San Antonio, Tex., and Chief Engineer of the Cross Town Street Railway, has resigned the latter position, at the request of the City Council.

J. O. Moss, of Sandusky, O., has accepted the Presidency of the Hocking Coal & Iron Co., and Gen. SAMUEL THOMAS, who has had no official connection with the company for the last two years, has agreed to take a seat in the board.

WILLIAM P. BIXBY, of Francistown, N. H., formerly a civil engineer on the Wabash, then on the Chicago & Indiana Coal road, but more recently on the Fort Scott & Western road, died recently, at Wichita, Kan. He was with W. S. LINCOLN, chief engineer of the Wabash, for ten years, commencing with Mr. LINCOLN as chainman.

WM. R. BILLINGS, formerly Superintendent of the Taunton Water-Works, and more recently connected with the Chapman Valve Mfg. Co., of Boston, has been elected Agent and Treasurer of the Taunton Locomotive Mfg. Co., of Taunton, Mass., and assumed the duties of his new office, August 1st.

THE following appointments are announced by the Atchison, Topeka & Santa Fé R. R. Co.: W. W. ALLEN has been appointed Superintendent of the coal interests in Kansas and Colorado; W. A. DRAKE has been appointed Assistant Engineer, with headquarters at Pueblo, Col. H. P. HALL, formerly Local Freight Agent at Denver, is appointed Assistant Superintendent of the Western Division, and will have direct charge of the train and station service. His headquarters will also be at Denver.

Col. JAMES N. SMITH, of Brooklyn, N. Y., a prominent railway contractor, died at his summer home, Litchfield, Conn., July 31, at the age of 54 years. Among the railroads in the construction of which Col. SMITH was connected were the "Nickel Plate;" the Delaware, Lackawanna & Western; the Union Pacific, (of which he built a section as the partner of Sidney Dillon, his brother-in-law); the Brooklyn, Flatbush & Coney Island; the Fourth avenue tunnel extension of the Hudson River Railroad; the St. Johns & Indian River Railroad, and the Atlantic Coast line in Georgia and Florida. He was also a member of a syndicate which had undertaken considerable railroad building in Canada.

A. J. EARLING, formerly First Assistant General Superintendent of the Chicago, Milwaukee & St. Paul, has been appointed General Superintendent, to succeed the late J. T. CLARK. J. B. MOLL, formerly Superintendent of the Iowa & Dakota Division, has been appointed to the newly created position of General Roadmaster, and the position of First Assistant General Superintendent will be abolished. The train service which Mr. EARLING has heretofore had charge of will be transferred to W. G. COLLINS, who has been Assistant General Superintendent, and who will have his office at headquarters, Milwaukee. C. A. COSGROVE, now Superintendent of the Prairie du Chien & Mineral Point Division, will succeed Mr. MOLL as Superintendent of the Iowa & Dakota Division. W. W. COLLINS, now Assistant Superintendent of the Chicago & Council Bluffs Division in Iowa, will superintend the Prairie du Chien & Mineral Point Division, The Iowa & Dakota Division, heretofore attached to the Middle District, will be transferred to the Northern District, and will be under the jurisdiction of Assistant General Superintendent C. W. CASE.

P. D. COOPER, formerly General Manager of the New York, Pennsylvania & Ohio R. R., died recently at Elkhart, Ind. Mr. COOPER began his railroad career as a telegraph operator on the Michigan Southern, now the Lake Shore & Michigan Southern, and later he was agent at the little station of Salem Crossing, now Otis, near Laporte, Ind. In 1865 he was promoted to the position of trackmaster. Then followed the Superintendency of the Detroit division, the Kalamazoo division, and later the Toledo division with headquarters at Cleveland. He had risen to the position of Assistant General Superintendent of the Lake Shore, when, in 1873, Gen. DEVEREUX, General Manager of that road, was appointed Vice President and General Manager of the Atlantic & Great Western, now the New York, Pennsylvania & Ohio, and Mr. DEVEREUX appointed him General Superintendent of the A. & G. W. Later he was appointed General Manager of the road and held that position until ill health compelled him to retire from active service in October, 1882. He was for several years president of the General Time Convention, and was widely known among railroad managers. While General Superintendent of the A. & G. W. he was offered, but declined, the general superintendency of the Lake Shore made vacant by the resignation of CHAS. PAINE.

The Proposed Civil Bureau of Harbors and Waterways.

The Engineers' Club of St. Louis addresses the friends of the Cullom-Breckinridge bill for the organization of a Civil Bureau of Harbors and Waterways, now before the House, and bases an excellent argument upon the opposition stirred up against this bill in the West, which classes it as a measure tending to abolish the Mississippi River Commission and in so much hostile to that improvement on past methods. The document proceeds to show that just as the River Commission was an improvement on previous local and practically disconnected action in that region, so the Cullom-Breckinridge bill simply carries the essential idea to a logical conclusion and extends its benefits over all the public works of the United States. The address refers to the wholly undigested manner in which estimates for public work now go before Congress, with the full knowledge that they will be scaled by the committees; and the advantages that would accrue to all concerned from the presence of a competent Bureau in Washington, whose duty it would be to first pass upon such estimates before they went to Congress, and be ready to answer all questions concerning the urgency or expediency of any particular work. Jobs to gain votes only could thus be eliminated and actually necessary work be pushed to completion, instead of expending trifling and inadequate appropriations in expenses of administration and repairs instead of progress, as results from present loose methods.

According to an exhibit condensed from the River and Harbor Bill approved Aug. 5, 1886, the exterior coasts of our country had 208 works and received $7,285,125; and the interior waters, including lakes, had 164 works and received $7,303,525; a total of $14,593,650. On July 1, 1885, the last statement available, there were in the Government employ on river and harbor work 70 Engineer officers, receiving an aggregate salary of $259,728 per annum, and 643 civilian employés of all grades receiving $904,480. This is a total of 713 officers and employés, and a total salary list of $1,164,208. The proposed organization would require 684 men, from Chief at $10,000 to cadet at $1,200 per year, and a total annual expenditure on pay of $1,188,000. That the change is not to be a violent one is shown by the proposed absorbtion of 53 out of the 70 U. S. Engineers now engaged on the works into the new bureau including in these the Chief Engineer. All of the present civil employés who can prove their fitness would go into the new organization.

The numerous arguments against the passage of the proposed bill are calmly and well met in this address. The advocates of purely special improvements of local benefit or advantage, would naturally oppose any rational scheme which would endanger their pets. The civil assistants in the present organization would necessarily lose their positions and be compelled to compete with other engineers under the new order of things; but the good engineer would be given a standing often in better accordance with his merits, and the fact that any engineer may fear that his present status is above what it would probably be in the new bureau, is a strong argument in favor of the bill and its purpose in seeking the best attainable engineering talent. The fear that the *personnel* of such a bureau would be soon degraded by political appointments, is met by the statement that this is a technical bureau and requires a service and knowledge rarely at the command of political office seekers, one for which they have no fitness and under the provisions of the proposed act could not be appointed. On the score of expense, the organization is based upon simply the present needs of the service, and if a continuous expenditure of from $15,000,000 to $20,000,000 per annum on public works should not command the best engineering talent in the land, it is hard to say what should. The opposition from many officers of the present Engineer Corps of the Army is natural; as to them the existing plan is a pleasant relief from all irksome military duties and is practically an independent position with a chance to make a name if ambitious.

The reasons given for the support of the bill may be condensed as follows:—It establishes a board of disinterested and competent men whose life-work it has been to prepare and execute plans for the improvement of rivers and harbors; whose business it will be to note the advantages of all improvements to the country's commerce, and who will be thus well qualified to judge of the necessity for and feasibility and cost of any proposed work. This board will be National and not local in its character. It would stop Congressional log-rolling and give continued, liberal and systematic support to worthy improvements. It would be economical. It will give to civil engineering outside of the Army, that recognition which is its due, and encourage civil engineers of ability to enter and remain in an organization which promises steady promotion for merit and in which the topmost round of the ladder invites all who are fitted to reach it.

The committee signing this address is made up as follows:—J. B. JOHNSON, R. E. MCMATH, E. D. MEIER, C. M. WOODWARD, F. E. NIPHER and WM. B. POTTER.

THE Glasgow (Scotland) Town Council is debating the propriety of working out about 1,500,000 tons of coal underlying the Glasgow Green in that City. There is opposition to the scheme, however, as the Green is the people's park and members of the Council argue that it is common property, and worth more in its present shape than the $350,000 estimated as the value of the coal.

Angels and Locomotives.

Our sketch shows a panel in the window lately uncovered in Westminster Abbey and intended to perpetuate the memory of that unfortunate Cornish engineer RICHARD TREVETHICK. While it is highly proper—though unusual—to so honor men of the engineering profession, there may be serious doubts as to the propriety of the design here shown in part. The window is a thorough decorative success, even if it does libel TREVETHICK'S engineering knowledge in the absurd locomotive ascribed to his inventive genius. But it is quite natural to ask what connection there is between a Cornish angel of very uncertain period and a "Railway Locomotive" of 1808? OFFENBACH in one of his operas makes CHARLES MARTEL start on a pilgrimage to the Holy Land on an express railway train. But this, in time at least, antedates MARTEL and radically upsets all previous history of the locomotive engine. Not content with holding up to public view the design given, other Cornish angels in the same window appropriate and display in a similar manner "Canal boats" and other alleged engineering improvements; all about as clear in purpose and design as the "locomotive" shown; as clear, in fact, as we can expect in angelic mechanism.

TO RICHARD TREVETHICK.

If his biographers do him justice, TREVETHICK was a hard-headed engineer who struggled with ideas in advance of his time; lived only to realize that his grandest conceptions had fallen upon barren places and bore no fruit, and died so poor in this world's goods that he was buried by charity. This man if anything was unsentimental, and he would have been the last one to mingle even the thought of Cornish saints and angels with the mechanical offspring of his busy brain. While it is somewhat of a satire upon man's gratitude to man, to think that this engineer had to die to be appreciated, and that the cost of this memorial window would have been a welcome fortune to the living man whose memory it perpetuates, we do not think his practical sense would have approved of this method of doing honor to his name. Among other things, the money expended on this piece of glazed nonsense would have founded a scholarship or prize with the Institution of Civil Engineers, and in assisting other engineers have honored TREVETHICK more than a dozen stained glass windows, even in Westminster Abbey.

Experience in Service of the New York Elevated Railways.

At the Convention of the American Society of Civil Engineers, of 1887, one of the most interesting and valuable topics discussed was the "Inspection and Maintenance of Railway Structures." In answer to questions Mr. R. I. SLOAN, Chief Engineer of the Manhattan Elevated Railway Co., in New York, gave some of his experience on the life and wear of this structure that is valuable.

These roads were first designed by careful engineers and constructed by responsible bridge-building firms, with good iron and good work combined. The entire system of 32 miles has been in use over 8 years and some parts 9 years, and in this time over 12,000,000 trains have passed over the roads. The structures have been submitted to a continuous light rolling load; but without imposing strains greater than good iron ought to stand. There is a daily thorough inspection and the structure is perfectly safe.

The structure, track, signals and buildings are in charge of the chief engineer and his assistants, the roadmaster and his assistants, four supervisors and the structure and track foreman. Daily reports upon defects in foundations, structure or track are made to the Chief Engineer and by him, on same day, to the General Manager of the road. In addition to this, Mr. ALBERT LUCIUS, M. Am. Soc. C. E., an expert bridge engineer, makes frequent examinations of the work and reports to the Chief Engineer every 2 or 3 months.

Increase of travel on the Third and Sixth Avenue lines has required heavier engines; from 17 to 19 and 21½ tons. To meet this increase in rolling load and keep within the required factor of safety the floor system on the Sixth Avenue and the Third Avenue girders have been strengthened. The 5×10-in. inside guard-timbers have been replaced by 6×8-in. timbers, and an additional stick put alongside the outer rail, making that guard 12×8-in.; 50 lb. rails are being replaced by 70 lb. rails and the pounding at rail-joints has been lessened by the use of improved supports and splice-joints, especially the Fisher joint. The greatest wear on the rails is on the curves of 90 ft. radius; these are renewed about every 18 months. The ties decay slowly and last from 8 to 10 years. The new ties are 6-in. deep by 8-in. wide. These ties are not creosoted.

For future structures Mr SLOAN recommended plate girders as being economical, stiff, trustworthy and requiring less inspection than short span, latticed or pin-connected trusses. The plate girders lately put in are 39 ins. deep; top chord 6×6 in. angles, 65 lbs. per lin. yd., and web ⅝ in. The rails are laid with broken joints, and square joints are preferred to bevel joints. No trouble has been experienced from the rectangular latticed columns.

During busy hours the trains run at a minimum of 2-minute intervals on the Third Avenue road; and as showing the safety of interlocking signal apparatus, at Chatham Square, about 3,000,000 trains have passed over the line crossing at this point with but one collision and that was owing to an engine-driver passing the danger signal. On an average 490 trains pass north, and 490 south on the Third Avenue line in each 24 hours.

Irrigation in the West.

All through the western part of the United States there is a strong and apparently increasing feeling that the proper development of the country demands the construction of great storage reservoirs in the mountains, which shall furnish an unfailing supply of water for irrigation. The project recommended by Major POWELL has led to the inauguration of other schemes of the same nature; and the important works already in operation, or in course of construction also help to keep the matter actively before the public.

If the estimates of the increase in value of land and products furnished by the promoters of the various schemes can be accepted with even a very generous allowance for possible errors, there is no doubt of the financial advantages to be gained by the construction of these reservoirs. Major Powell says of the result attainable:

"The area of the arid territory requiring irrigation is about 1,300,000 square miles. Of this about one-fifth is too rugged or too elevated to admit of cultivation under any condition of agriculture likely to arise for a century to come. A smaller fraction consists of plazas or drainless desert plains so flat that it is impossible to wash the salts from their soils. There remain about one million square miles which need only water to be rendered productive. At the minimum price of public land, $1.25 per acre, a price greater than its value for pasturage, this land has a valuation of $800,000,000; at $30 per acre, a moderate estimate of its value when irrigated, it would be worth $19,200,000,000. The water which falls in the arid region would fully meet the agricultural needs if only it could all be stored until the proper season and then conveyed to the proper land. Unfortunately many causes conspire to render this impossible. Of the water from rain and melted snow which gathers in channels and forms streams only a portion has such relation to arable land that it can be utilized; the remainder flows too low or at such distance from the land as to be beyond the economic limits of conveyance. Under such adverse conditions it is manifest that only a small portion of the rainfall of the region can be made to serve the farmer, and that there is no solid foundation for the opinion sometimes expressed that the greater part of our arid West will ultimately be reclaimed. An estimate based on such data as is available leads to the anticipation that when all the larger streams have been brought under control and the storage of water has been carried as far as it may be economically there will be redeemed about 15 per cent. of the region, or 150,000 square miles, the whole comprehending an area which exceeds one-half of the land now cultivated in the United States. At $30 an acre this will add $2,880,000,000 to the wealth of the nation."

In the Columbia basin in eastern Washington it is estimated that a very large area could be made available for growing wine grapes, and the value of the land be very much enhanced. In Montana Major Powell's plan is received with much favor. Of the 93,000,000 acres of land in Montana the mountains cover about 35,000,000, and a very large part of the rest, including valleys and plateaus, could be made productive by the use of reservoirs.

As a case in point, illustrating the efficiency of the reservoir system, a work recently completed in Elko County, Nevada, is cited, the data being taken from an account in the Salt Lake *Tribune*:

"A small stream emerges from a mountain canyon, and ordinarily furnished water enough to irrigate about two ranches. Two men bought 10,000 acres of sage brush land, and by the aid of capital raised in England, after vainly trying to secure it in this country, constructed a permanent dam in the canyon, going down to bed-rock and giving it an ample base of 250 ft. width and a height of 50 ft. The reservoir has been filled, and already 1,500 acres are under cultivation. This year they will cut 4,000 tons of hay, worth $15 a ton. Each year they clear and put under cultivation 500 acres, and their water supply promises to be ample for the purpose."

Terminal Facilities of St. Paul and Minneapolis.

The yard area in use in St. Paul and Minneapolis is by no means meagre in extent; but if the present rate of increase of railway business continues the terminal facilities must soon become inadequate.

According to the *Pioneer Press*, there is not a railway company whose lines enter either of the two cities which does not already begin to be cramped for room. There are 274 trains entering and departing at the union depot daily. In the past five years the number of passenger trains has doubled and the freight traffic increased so enormously that the railway companies have been obliged to leave the river front to obtain sufficient yard room. In 1887, 162,016 cars of freight were received and 96,448 shipped; in 1886, 122,381 cars were received, and 72,267 shipped.

The topography of St. Paul and vicinity makes railroad approaches to the business centers possible only through long valleys with comparatively heavy gradients, and their convergence on the river front on the site of the old Choteau swamp has made that locality a network of tracks.

At present St. Paul has 816 acres and Minneapolis 762 acres of yard room in actual use; when the Union depot and the Union Stock yards are added the total reaches 2,000 acres for terminal purposes. Compared with other cities this area would seem to be all sufficient for the future, but when we consider that the first train of cars moved out of St. Paul in 1862, the probable requirements of the near future become more evident.

DEATH IN ELECTRIC CURRENTS:—A controversy in regard to the relative death-dealing propensities of high tension continuous and alternating electric currents, which has been going on in New York City, for some time, brought about a meeting recently at which HAROLD P. BROWN delivered a lecture and was to show by experiments on dogs just how the currents acted. A dog was subjected to continuous currents varying from 300 to 1,000 volts and was still alive. He was then killed by an alternating current of 330 volts. The investigations were to have been continued, but before the second dog was operated on an agent of the Society for the Prevention of Cruelty to Animals stopped the experiments. An advocate of the alternating system then offered to put T. CARPENTER SMITH forward to take a 1,000-volt shock from an alternating current, if Mr. BROWN would stand a continuous current of the same intensity. It is needless to say that this proposal did not meet the approval of either Mr. SMITH or Mr. BROWN.

ENGINEERING NEWS.

THE Pennan bridge on the Madras railway, in India, is to be reconstructed at a cost of about $500,000. The *Engineer* of London, reports the original bridge as an absolute failure, and ascribes the condition of affairs to rumored bribing to pass bad material and work. Our contemporary very properly deplores the fact that it was an English bridge built by English engineers.

THE prospects look well for heavy guns for our forts. In the House Appropriation bill is an item of $750,000 for equipping the Watervliet Arsenal as a gun factory for finishing heavy ordnance; and the Senate amendment to the House bill appropriates $6,350,000 for ordnance and torpedo purposes, which total includes the Watervliet Arsenal equipment. The items and ultimate expenditure for the current fiscal year are not yet settled upon, but both bodies now seem determined to have guns and a place to finish and assemble ordnance of calibre up to 16-in. rifles.

THE cost of the New Naval Observatory buildings on Georgetown Heights, near Washington, will be, exclusive of piers and domes, $307,811. There are nine buildings in all: the building where the great equatorial telescope will be mounted; the clock room, in which the observatory clock and the naval chronometers will be kept; two buildings for observer's rooms; the east and west transit buildings the boiler house, and the main building. The work is to be completed in 18 months.

The Argentine Republic is being overwhelmed with railway projects, no fewer than 33 new lines having been laid before Congress since the opening of the session in May. Of these only six or seven are of immediate importance. All the proposals are sent to the Engineer's Department, where they will be examined and the routes laid down on a general map, so that concessions will not be granted to competing or unnecessary lines. A measure is before Congress by which all railway concessions will become invalid if not signed within 2 months after the passage of this new law; this will effectually dispose of any wildcat schemes in the long list of applications for concessions.

THE VESTIBULE CAR SUIT.—In the United States Circuit Court, Chicago, July, 30, Judge BLODGETT presiding, the suit of the Pullman Palace Car Co. against the Wagner Palace Car Co. and the Lake Shore & Michigan Southern Railroad, to enjoin the use of vestibule cars was called and the defendants giving bond, with W. K. VANDERBILT and others as sureties to the approval of the court, to secure the Pullman Company against damages, the order of injunction was set aside and dissolved, pending a final hearing, which will be in October next.

ELECTRIC STORAGE CARS.—The Lehigh Avenue Railway, Philadelphia, is expected to be opened within two months. It will be operated by cars of the Electric Car Co. This is the Wharton storage system with which the Reckenzaun inventions are identified. A car of this system is now running upon the Lombard & South Street Railway, Philadelphia. Though but a 16 ft. car, it is mounted on two 4-wheeled trucks. One hundred storage cells are placed under the seats, and the motor applies its power to the axle by worm-gearing. The weight of the electrical apparatus and machinery is 5,800 lbs. and that of the car 9,200 lbs., a total of 15,000 lbs. The car is lighted by electricity, and a 50 c. p. incandescent light with reflector, serves as a headlight.

THE RAILWAY ELECTRIC CAR LIGHTING & SIGNAL Co., has been incorporated at Newark, N. J. The place of business is East Orange. The company is to have branches in all the principal cities of the Union. Its objects are the supplying of electric light, heat and power, electric apparatus, signals, switches, switch towers, to railroads. The company will commence business with $1,000. The incorporators are: WILLIAM BRACKEN, New York; HENRY G. MORRIS, Philadelphia; HENRY WESTON, New Brunswick.

An Engineer's Experience.

The St. Louis *Globe-Democrat* gives the following breezy account of railroad building in Kansas, which purports to be the story told by a contractor (more probably an engineer) on one of the lines of the Missouri Pacific system, built last year:

"Everybody knew that the road was being built by the Missouri Pacific, and they did not know any of the intermediaries, and so took me for a direct representative of JAY GOULD. I had not been there a fortnight when I assured myself that we were being swindled right and left, and reporting the fact was given full authority. I had to discharge every superintendent and every head of department on the whole contract. It was the most complete ring that you ever imagined. The work on the road was easy enough, but the amount of excavation was over measured and the amount of filling overpaid. Everybody was getting a whack out of the contract, and they did not hesitate to turn the road one way or the other, according as the neighbors chose to pay for it. They were building the line solely in the interest of the local and individual interests, and they were working a dummy pay roll and collecting wages for men who had never done a stroke of work on the contract.

"There was a little town on the line which was almost entirely controlled by one man, and he was working the new road for all it was worth; while others gave the right of way, he had charged us a high price, so high that I knew he must have divided with some of our men, and I made up my mind that, somehow or other, the company had got to get even with him. There were only about 500 people in the place, and they had a meeting to vote on the question of raising $2,500 to lay out a highway. I found he was working the same racket on the city that he had on us, and that the road was of more interest to him than all the rest of the town put together. I had then about 600 men at work on our contract right there, and as they are not very particular about citizenship out West, I managed to vote almost every man of them against him. This defeat seemed to make it necessary for him to run for Mayor, and he came to me with an offer of $1,000 cash not to interfere."

A WORKMAN in the Carson mint is said to have made the discovery that drill points may be so tempered that they will penetrate the hardest steel or plate glass by heating them to a cherry red and then driving them into a bar of lead.

AN OLD WATER SUPPLY TUNNEL.—A recent German expedition has again explored the tunnel near Samos, dating from 530 B. C. It was built as a water conduit; was 1,235 ft. long and has near it upper end a large covered reservoir.

SOCIETY PROCEEDINGS.

American Society of Mechanical Engineers.—A circular has been issued making the preliminary announcement for the Eighteenth Convention of the Society, which will also be the Ninth Annual Meeting. The Council have accepted the cordial invitation of the Board of Trade of the city of Scranton, Pa., to hold its meeting in that city, beginning Monday evening, October 15, and a later circular will give the details of sessions, excursions, etc. The meeting comes somewhat earlier this year than usual, in order that the hill country of Pennsylvania may be enjoyed to the best advantage, and the meeting has been assigned, under the rules, for this date, with that object in view.

The Society has so generally endorsed the plan of having all its papers in print and distributed in advance to those who expect to attend the meeting, that the attention of those who intend to present papers at this coming meeting, is especially drawn to the necessity of having their papers, with illustrations, etc., complete, in the hands of the Publication Committee not later than August 20. The Secretary would solicit papers giving short accounts of engineering experiences, and also papers for the economic section of the Society's work on topics related to shop orders, methods of accounting, of superintendence, and management, and particularly of ascertaining cost of work. The Society's system of presenting and discussing papers enables it to handle exhaustively a large number of papers at a convention, and the privilege and duty of contributing in this way to the Society's work is urged on everyone, even if he cannot expect to attend the meeting in person.

F. R. HUTTON, *Secretary.*

New England Roadmasters' Association.—The Sixth Annual Meeting of the Association will be held at the United States Hotel, Boston, Mass., August 15 and 16, 1888. Meeting will be called at 1.30 P. M. August 15 and with proper intermissions, there will be work done until adjournment on evening of August 16.

After the regular annual business of the Association, viz:—Reading of the minutes of last meeting, enrollment of new members, reading communications, election of officers, report of committees, unfinished and miscellaneous business—there will be discussed the following questions:

Highway Crossings.—Best form for flangeway and economy of maintenance; carpenters or trackmen to do work on same.

Steel Rails.—Weight, section, inspection before acceptance, unloading from cars, shall it be curved before laying on curve? If to be curved how shall it be done? Shall it be broken or square joint, supported or suspended at the joint?

Necessary monthly or weekly forms for the rendering of material used and classification of labor performed.—Are the use of same understood, and give the results desired?

The maintenance of the road-bed outside of the rails.—Proper time to mow and burn the brush and weeds; the most economical way to dispose of old ties; care of station grounds; general care of section as regards its looks without much loss of time of trackmen.

Nut Locks.—The best in use and does it pay to use them?

Road Tools.—Improvement of same and value of such over former tools in use?

Review of Questions discussed at previous years meetings.—There have been committees appointed on each question, who will report on same as each question is opened for discussion.

P. A. EATON. J. R. PATCH,
L. H. PERKINS, GEO. NEVENS,
G. W. BISHOP, W. F. ELLIS,
J. H. LANE,
Executive Committee.

The Interstate Deep Water Convention held at Fort Worth, Tex., July 10 and 11, is the beginning of an organized movement to secure a deep water port on the Gulf coast of Texas. The basis of representation decided upon was the last popular vote cast in the various States, one vote in the convention being allowed for every 500 votes in the last State elections. A permanent organization was effected, General R. A. CAMERON of Colorado, being elected President, and T. J. HURLEY of Tarrant, Tex., permanent Secretary.

In his address on taking his seat, President CAMERON said that "the object of the Convention was to create an enthusiasm in a movement which would certainly result in great and lasting benefit to the Northwest Texas being the garden spot of the Republic, a deep water port on the Gulf coast would certainly do much to develop the great Northwest, from which to the sea Nature had provided a superb waterway."

Resolutions were adopted expressing the sense of the Convention as follows: The interests of Texas, adjoining States and all the Northwest demand a first-class port on the coast of Texas; that the U. S. Government should appoint a board of competent engineers to select a location for the port; that a memorial should be presented to the Senators and Representatives from the States interested requesting them to urge at once the appointment of such a board of Engineers; that Senators and Representatives be requested to secure adequate appropriations for the work; that the efforts of private parties to secure deep water be endorsed, and that their re-inabursement by the general government be recommended in all cases where a depth of 20 ft. has been attained, and that an appropriation of at least $5,000,000 should be asked for. It was also resolved that the citizens of Denver be requested to call another Interstate Deep Water Convention, not later than Sept. 15, 1888.

After voting thanks to the Fort Worth Board of Trade and to the Commercial Club, the Convention adjourned.

CONSTRUCTION NEWS.

RAILROADS.

East of Chicago.

Existing Roads.

Zealand Valley.—

ZEALAND, Coos Co., N. H., July 27, 1888.

EDITOR ENGINEERING NEWS:

The Zealand Valley Railroad extends from Zealand, in the town of Carroll, south into Bethlehem a distance of 7¾ miles, with about 5 miles of branches. The grades average about 200 ft. Steepest grade is on a ¾-mile stretch, where it is 285 ft. per mile. The road is a private enterprise and is owned by J. E. Henry & Sons of Zealand, N. H. It is used mainly for drawing out wood and timber, but during the summer months carries passenger excursions. Tracklaying is to begin on an extension about October 1, and it will be completed by Dec. 1. RAY. T. GILE of Littleton, N. H., is Chief Engineer. The work is all done by the owners of the road. G. E. HENRY.

Toledo, Saginaw & Muskegon.—It is announced that this Michigan railroad, which was built last season from Ashley to Muskegon, Mich., a distance of 96 miles, and was to form part of the Toledo, Ann Arbor & North Michigan system, has been transferred to the Grand Trunk Company. It is intended to run through trains from Detroit across the State to Muskegon, connecting

there with a steamer line across Lake Michigan to Milwaukee, Wis.

Lehigh & Hudson River.—It is announced that the control of this company has passed into the hands of the Central Railroad of New Jersey. The line extends from Belvidere, N. J., to Greycourt, N. Y., a distance of 63 miles. It is supposed to be the intention of the new owners to begin work at once on an extension to a connection with the Poughkeepsie bridge.

New York, Mahoning & Western.—A new bit of complication has turned up in this company's affairs. The Mahoning Construction Company, who had the contract for building the eastern division of the road, were unable to pay their bills and the contract with them was turned over to the Allegheny Construction Company of Pittsburg, Pa., who are building the western division. The Mahoning Construction Co., however, objected to this and stopped the running of trains on the completed division from Ottawa to Findlay, O., 22 miles, by a court injunction, the day after it was opened for traffic.

Grand Trunk.—The plans were prepared a year ago for the removal of grade crossings on this company's terminals in the city of Montreal, at an estimated cost of $250,000. Some months ago the company offered to pay one-tenth of this, but no action was taken. A conference is to be held soon, however, and it is likely that arrangements will be made for the division of the expense between the city and the company, and an early undertaking of the work.——Grading has begun on the South Norfolk railway, which is to run from Port Rowan to Simcoe, a distance of 17 miles, and it is hoped to complete it before winter sets in.

Lancaster & Hamden.—It is reported that grading is to be resumed on this Ohio road at once, the difficulties between the contractors and subcontractors having been adjusted, and new sources for funds secured.

Louisville, New Albany & Chicago.—The sudden fall in the stock of this company from 66 to 40 has given rise to some comment, and reports of a probable lease to some of the larger systems are in circulation. The rumors, however, are denied by the company's officers.

Toledo, Columbus & Southern.—The four-mile extension of this road from Findlay, O., south, which was ordered by the court some time ago, has been completed, as has also its new depot and terminals at Findlay. An attempt will be made to continue the line to Dunkirk this season.

Long Island.—The company has planned much work in connection with its Oyster Bay extension. The route of the North Shore division between Woodbury and Port Jefferson is to be changed so that the line will run close to Cold Spring, Huntington and Northport.

Pittsburg & Western.—President JAS. CALLERY, of Pittsburg, is reported as giving the following account of the Pittsburg, Akron & Western project:

"The Pittsburg, Akron & Western railway, from Akron, O., a distance of 165 miles, is now being surveyed by an engineer corps under WILLIAM SEMPLE, of Allegheny. Eastern parties, including Dr. NORVIN GREEN, Judge PIERREPONT and others, have taken the enterprise in hand and the money will be forthcoming. At Delphos, O., this road will connect with the Toledo, Cincinnati & St. Louis system. At Akron, for the East, it will connect with the Pittsburg & Western road. This will give us a new and direct outlet to the South and West, and connection with great systems to the Pacific coast. Taken in connection with the Pittsburg & Western, the new route will be a few miles shorter to Chicago from Pittsburg than the Ft. Wayne, even possessing an additional great advantage of lower grades. It is of great importance to Pittsburg, and besides rivalling the Ft. Wayne road, of the Pennsylvania system, it will be an equally advantageous route to St. Louis, intermediate points, and points beyond with the Panhandle of the Pennsylvania system. The Panhandle is one true line to St. Louis, this is another. Our running distance to Chicago will be 25 miles less than it is now.

"The proposed line to make the connection East has been on paper for two years, but now the company, whose headquarters is in New York City, is regularly incorporated and officered, and the road will eventually be built. It is the American Midland, to run from a point near Mauch Chunk, Pa., on the Lehigh river, to Parker, Pa., on the Allegheny river, a distance of about 250 miles, where it will complete the new route by connection with the Pittsburg & Western. At its Eastern terminus it will make connection with the Jersey Central, Delaware & Lackawanna and Lehigh Valley Railroads, which have no direct Western outlet. Each of these lines is interested in the building of the new line, as each would profit greatly by it. Their anthracite product would be given a great outlet to the West."

Western Maryland.—Keller & Crosson of Lancaster, Pa., have the contract for the extension of the Baltimore & Harrisburg division from Orrtanna, Pa., to Blue Ridge Summit, Md., 15 miles, reported in our issue of July 21. They have sublet 2 miles, including a 500-ft. tunnel, to Hugh Keogh of Lancaster and P. P. Reilly of Altoona.

Lake Shore & Michigan Southern.—An iron bridge will be built across the Portage river at Port Clinton, O. Various improvements are in progress on the Norwalk and Sandusky divisions under direction of Chief Engineer OSGOOD.

Port Jervis, Monticello & New York.—A court injunction has been issued, obliging the Erie to afford terminal facilities to this company at Port Jervis, N. Y., from which it has been shut out for several weeks.

Ohio, Indiana & Western—Work is to begin at once on the new terminal facilities at Springfield, O., the cost of which is estimated at $160,000.

Baltimore & Ohio.—It is reported that the company's managers are making arrangements to carry through the original plans for a terminus at Staten Island, and that engineers are now locating the line between Roselle, N. J., and the Arthur Kill bridge.

Lake Shore.—The contract for building this road from Alton Bay to Laconia, N. H., has been let to JAS. K. RYAN & Co., of New York City. Work is to be begun in 10 days and to be completed in 3 months.

New Projects and Surveys.

Utica & Unadilla Valley.—

LEONARDSVILLE, N. Y., July 26, 1888.

EDITOR ENGINEERING NEWS:—The Utica & Unadilla Valley R. R. is to begin at Bridgewater, Oneida Co., N. Y., and run *via* Unadilla Forks, Leonardsville, West Edmeston and South Edmeston to New Berlin, a distance of 20 miles. The line is to be resurveyed in about two weeks. About $50,000 has been subscribed to the project in this vicinity, and it is desired to raise $150,000 more. The project is in the interest of Utica and the towns along the line, and is independent of existing roads. The company to build and operate the line has not yet been organized. H. D. BABCOCK.

Utica, Adirondack & Saratoga.—

UTICA, N. Y., July 25, 1888.

EDITOR ENGINEERING NEWS:—

This railroad is to run from a point on the Rome, Watertown & Ogdensburg Railroad, about 20 miles north of Utica, through the towns of Prospect, Gang Mills, Grant, Northwood, Ohio and Noblesboro, a distance of 21 miles. The enterprise is projected to benefit Utica and the towns along the proposed line. The earthwork will be moderate and there will be very little rock and not much bridging. Preliminary surveys have been made and mapped. Capital for building has been partly secured by stock subscription, and right of way is now being secured. Hon. H. J. COOKINHAM, of Utica, is President of the company. R. W. SHERMAN, *Chief Engineer.*

George's Valley.—

UNION, Me., July 27, 1888.

EDITOR ENGINEERING NEWS:—

The George's Valley Railroad is projected to extend from Augusta, Me., *via* Liberty and Union to Warren Station, on the KNOX & LINCOLN Railroad, a distance of 40 miles. The project is being advocated in the interest of manufacturers and dealers along the route, and the matter of a survey of the line is being agitated.

B. BURTON.

Northern Maine.—"The line just completed from Mattawamkeag to Patten on the preliminary survey for the Northern Maine railroad runs up the Mattaceunk valley, a part of Salmon Stream valley, thence through Sherman near the county line of Penobscot and Aroostook, crossing the west branch of Molunkus, following the low lands of Patten. That part of the line by Mattaceunk lake is reported not entirely satisfactory, and Mr. Danforth has started to make an examination of the Salmon stream or what is called the Hilton survey and Molunkus valley route".—*Portland Press.*

Middletown & Hummelstown.—This company has filed articles of incorporation in Pennsylvania.

Maine Shore Line.—President J. E. GREENE, of Machias, is reported to have given the following account of this enterprise:

"The Shore line is now a sure thing. I mean to push the work as fast as I can and have the road completed as soon as possible. Cherryfield gives $15,000; Harrington, $400; Columbia Falls, $300; East Machias, $17,000; Machias, $30,000; and the other small towns along the surveyed line give in proportion. Pembroke has not voted yet. Eastport is heavily in debt, and they cannot bond the town for much more, so I don't know yet exactly how much they will aid altogether. Whatever they do give will be raised by subscription, and by a direct tax. Several parties have already offered from 3,000 to 5,000 each. You see Eastport is going to receive a great benefit from the road, for it will be the terminus, and they will probably furnish from $35,000 to $50,000 in all."

Walhonding & Mohawk Valley.—This company has been incorporated in Ohio with a capital stock of $1,500,000 to build a railroad from Jefferson, Coshocton county, to a point on the Cleveland, Akron & Coumbus road in Bedford township. JOHN MACKEY, E. B. MACKEY, J. O. CRANE and others are the incorporators.

SOUTHERN

Existing Roads.

Rome & Decatur.—The last spike on this road from Rome, Ga., west to Atalla, Ala., 62 miles, was driven on July 27. Construction was abandoned on the line a year ago at the time of the failure of Grovesteen & Pell, of New York City, when about 15 miles had been completed on each end. A reorganization of the company's affairs was effected last spring with EUGENE KELLY, of New York, President; J. W. OGDEN; Vice President; and F. M. BARNUM, Secretary and Treasurer. Since then work has been pushed and the 32-mile gap is now finished. DANIEL CALLAHAN was the contractor for construction; P. H. THOMSON was Chief Engineer; and S. Z. RUFF was Engineer in Charge of Construction; the Superintendent of the road is R. A. BACON.

Anniston & Cincinnati.—Trains are now running on this Alabama road between Anniston and Atalla, a distance of 36 miles. The tunnel on the line is not yet finished, and passengers are transferred around it for the present.

Mobile & Dauphin Island.—It is rumored that construction is to be resumed on this road from Mobile to Dauphin Island, Ala. Work was abandoned nearly a year ago and the debts owed by the contractors are still unpaid.

Jacksonville, Tampa & Key West.—It is reported that this Florida system is to be consolidated with the Florida Southern railroad.

East & West Alabama.—EUGENE KELLY of New York City, has purchased the controlling interest in this Alabama company and new officers have been chosen. CHAS. M. FRY is President, F. A. POTTS is Vice-President and WM. H. FARRELL Treasurer.

Louisville & Nashville.—The directors of this company, have declared another scrip dividend of 3 per cent. ——Grading is in progress for the extension toward Huntsville, Ala., on the 19 mile division between Village Springs and Chepultepec.

East Tennessee, Virginia & Georgia.—The negotiations for the sale of the controlling interest held by the Richmond & West Point Terminal Co., to the Norfolk & Western are still in progress. But it is generally deemed certain that the transfer will be effected. The directors of the two companies have elected conference committees who are to arrange the terms of the sale.

Carolina, Cumberland Gap & Chicago.—About 15 miles of track are down on the division from Aiken to Edgefield, S. C.——The survey from Pickens to Asheville, across the Blue Ridge, is now in progress.

Kentucky Union.—About 1,200 hands are at work grading the extension of this Kentucky road between Clay City and the Kentucky river, and between Winchester and Kentucky Union junction.——It is stated that the company will not build from Hedges Station to Lexington, but will secure running rights over the Newport News & Mississippi Valley road. This would certainly be a most commendable idea, as the construction of a parallel line would thus be avoided; but it is said to greatly rouse the ire of Lexington citizens, nevertheless.

Kentucky Midland.—This company seems the most fortunate in obtaining local aid of any railroad enterprise now under way. The city of Paris has just voted a subsidy to the company of $50,000, which makes a total of $300,000 in subscriptions from Bourbon county alone.

Charleston, Cincinnati & Chicago.—J. H. AVERILL, of Charleston, is reported as follows with regard to progress of construction on this line:

"The business of the road between Camden and Lancaster has increased quite materially and to such an extent that it is easy to predict a great future from the encouraging present. We crossed the Catawba river on the evening of July 19, and on the evening of July 21 the track had reached the crossing of the Georgia, Carolina & Northern road, which runs from Chester to Monroe, two miles north of the Catawba river. At No. 13 trestle there will be consumed about eight days in putting up the structure. The track will reach Rock Hill between August 5 and 10, and will be opened for traffic, passenger and freight, about August 20. This will place 65 miles of the Southern division of the road in operation.

"Thence tracklaying will be pushed on to Yorkville, and it expected that the road to that point will be open to traffic not later than September 20. On or about November 1, the gap of 24 miles between Yorkville and Black's will be laid with rails, and at Black's the Southern division will connect with the Rutherford division, which is now in operation, 44 miles from Black's to Rutherfordton *via* Shelby. On the 1st of November, therefore, the Three C's will be in operation from Rutherfordton to Camden, a distance of 146 miles.

"It is expected that the line from Rutherfordton to Marion, a distance of 20 miles, will be completed and in operation by Feb. 1, 1889, which will give connection with the Western North Carolina R. R., at Marion, N. C."

Cape Fear & Yadkin Valley.—Chief Engineer ATKINSON has completed the surveys on the extension from Fayetteville to Wilmington, N. C.

New Projects and Surveys.

Hartford & Fordsville.—Preliminary surveys are completed on this Kentucky line, and work obtaining local aid and right of way is to begin at once.

Gulf & Chicago.—C. C. MERRICK, of Chicago, the president of this proposed road, states that surveys have been made from Mobile, Ala., to Clarksville, Tenn., and that a contract has been let and work has begun on the 30 mile division from Faunsdale, Ala., to Cedar Point.

Kingston & Emory Gap.—It is reported that work will begin on this line, 7 miles in length, from Emory Gap station, on the Cincinnati Southern Railway, to Kingston, Tenn., by August 15. EDWARD SHELLEY, of Newbern, Va., is chief projector. (See ENGINEERING NEWS, Feb. 25, 1888, p. 150.)

THE NORTHWEST.

Existing Roads.

Northern Pacific.—The terms of the agreement which has been entered into between the company and the Manitoba government have been made public. The company agrees to purchase and operate the Red River Valley road, to build the extension to Portage la Prairie at once, and next year to continue the line to Brandon. No stipulation is made with regard to branches, it being deemed certain that the company will deem it for its own interest to construct such feeders as are advisable. A maximum schedule of rates has been agreed on, which is understood to be considerably lower than that now in force on the Canadian Pacific. The company also agrees not to enter into any pooling arrangement with the Canadian Pacific. The Government guarantees interest on bonds to the amount of $6,000 per mile at 5 per cent. for 25 years; but this of course is only operative in case the earnings over running expenses are not sufficient to pay the interest. The work of construction and opera-

tion will be carried on in the name of the Government, though practically by the Northern Pacific, and tenders will be called for soon for building the line to Portage la Prairie. The Agreement as made by Premier MARTIN and Attorney General GREENWAY will be submitted to the Provincial legislature for ratification.

Winnipeg & Hudson Bay.—The Winnipeg *Free Press* attacks the government for its action with reference to the Hudson Bay project, for carrying through which, it was recently reported, ANDREW ONDERDONK and NICOL KINGSMILL were anxious to make arrangements. It is claimed that the government refused to treat with the above named gentlemen at all, and that the trip of the Premier to New York was for the purpose of letting the Hudson Bay enterprise to other parties. The attack seems to have been based more on malice than on facts.

St. Paul, Minneapolis & Manitoba.—Workmen grading for this company near Sauk Centre, Minn., have struck for an advance from $1.50 to $1.75 per day.

Winona & Southwestern.—The bill permitting this company to build a bridge across the Mississippi river at Winona has passed the House of Representatives and is now pending in the Senate.

New Projects and Surveys.

Sioux Falls, De Smet & Northern.—A party has started from Sioux Falls, Dak., to make a preliminary survey of this line, which is rumored to be projected in the interest of the Illinois Central. The members of the corps are F. A. BRATKA, P. G. BURNS, J. A. MCFEE, F. S. TERRILL, CHAS. FUNKE, OSCAR FINKELNBURG and C. S. RANDALL. M. S. PARKER is Chief Engineer.

Duluth, Red Wing & Southern.—A construction company has been organized to build this Minnesota road, and strenuous attempts are being made to obtain capital from the East. F. W. HOYT, of Red Wing, is President.

Chicago, Paducah & New Orleans.—The surveys on this line have been made from Shumway, Effingham county, Ill., south to Harrisburg, Saline county, a distance of 112 miles. The engineers are now at work in the mountains of Pope county.

THE SOUTHWEST.

Existing Roads.

Kansas City, Fort Scott & Memphis.—The company has declared a semi-annual dividend of 4 per cent. on preferred stock and 1 per cent. on the common stock. This is a smart reduction from last February, when a 2½ per cent. dividend was paid on the common stock. The demoralization of rates in the Southwest is a chief cause of the reduction.

Chicago, St. Paul & Kansas City.—This company announces the completion of its line to St. Joseph, Mo., and that traffic will now be received.

Kansas City & Sabine Pass.—This company has placed on file at Nevada, Mo., a mortgage to the Holland Trust Co., of New York City, to secure bonds to the amount of $2,000,000.

San Antonio & Aransas Pass.—Good progress has been made in obtaining subscriptions for the extension from Comfort to Llano, 60 miles. The company agreed to build bridges and culverts and lay the track, if the towns along the line would do the grading.

New Projects and Surveys.

Omaha, Dodge City & Southern.—We have received marked copies of papers published in Dodge City, Kan., giving lengthy accounts of this enterprise, described as "One of the greatest railway schemes of the age. From Omaha to Dodge City. Then to the Gulf of Mexico" For a specimen of "English as she is wrote" in the boundless West, one of the articles is well worthy of reproduction; but we have only space for one or two extracts:

"This road, the name of which heads this article, when built, and the building of which is a certainty, if for no other tangible reason it is a child of absolute necessity. In the minds of men who are now pushing it on toward completion, it has been conceived, and ultimately will be born, christened and prove to be a giant on account of its possibilities, and immediate patronage."

"This route was from all previous efforts considered impracticable but the survey being made is the most desirable and direct, making almost an air line without any heavy grade, and through many fine growing cities and wealthy counties."

"Let us hear the whistle of the engine from the north, and let us see her smoke curl heavenward as she pulls on for the plains of Texas; never stopping save to take on her immense amount of freight between the great city of Omaha and the Gulf of Mexico."

We find by our records that the Vice-President and Chief Engineer of the road rejoices in the name of C. E. GALLAGHER, and are surprised that the eloquent eulogist of the above enterprise did not take advantage of that fact to "adorn his tale".

Fort Smith, Paris & Dardanelle.—President CLEVELAND has vetoed the bill granting right of way through the Indian Territory to this company, on the ground that indiscriminate grants to railways permitting them to cross lands occupied by the Indians, if not in absolute violation of treaty rights, are dangerous to the success of the Government policy of Indian management.

New Orleans, Natchez & Fort Scott.—L. D. LATHAM, of Chicago is making a trip over this line with President JOHN H. RICE. It is stated that grading will surely begin by Sept. 1.

Dallas & New Orleans.—J. B. SIMPSON, of Dallas, Tex., is one of the chief projectors of this Arkansas road.

Chicago, Hannibal & Springfield.—The headquarters of the engineering staff of this company have been removed from Mexico, Mo., to Chicago, Ill., and surveys are to be made this fall upon the proposed line through Illinois.

Lake Providence.—A meeting was recently held at Lake Providence, La., of the Carroll Parish Improvement Association. A committee was appointed to ascertain the feasibility of building a railroad from Lake Providence to the Macon hills.

ROCKY MOUNTAIN & PACIFIC.

Existing Roads.

Portland & Vancouver.—Tracklaying has begun on this line at Portland, Ore.

Colorado Midland.—It is reported that surveyors are at work laying out a new line across the Saguache mountains which will do away with the Hagerman tunnel and 10 or 12 miles of the line by which the ascent to that point is made. The new line would involve the construction of a tunnel about 3 miles in length, and it seems altogether improbable that it is intended to abandon the line just opened on which so much has been expended, when to do so would involve a further heavy expenditure of capital.

Southern Pacific.—NELSON BENNETT has the contract for building the Carbonado branch to coal mines in Washington Territory.—The rumor that the company intends to build north to a terminus at Seattle is officially denied.

Mexican Interoceanic.—The following item is being circulated:

A LARGE TUNNEL.—CITY OF MEXICO, July 27, via Galveston.—The Interoceanic Railway on Wednesday began the work of opening a tunnel 201 kilometers long, from Calpulalpan, on the road to Pueblo from this city. It will be the largest tunnel in the republic.

Yes, it would be a pretty large tunnel, something over 124 miles long! Evidently the American public is not yet thoroughly familiar with the metric system.

San Francisco and San Joaquin Valley.—It is reported that 20 miles of track have been laid on this California road, and that Supt. of Construction, T. J. DRAKE announces the positive resumption of work by Aug. 15.

Eureka Flat and Walla Walla.—About 30 miles of track have been laid on this Washington Territory road which is being built by G. W. HUNT.

San Francisco & Northern Pacific.—On the Cloverdale & Ukiah extension of this California road grading is finished to a point within 6½ miles of Ukiah. The last tunnel, 441 ft. in length, has been completed and tracklaying is to begin very soon.

Silverton.—

SILVERTON, Col., July 23, 1888.

EDITOR ENGINEERING NEWS:

In your issue of June 16, you mention the "Silverton & Red Mountain R. R." This should be the "Silverton R.R." Surveys are made to Ironton, 14 miles from Silverton, through the Red Mountain mining district. Track is now 8 miles from Silverton and grading is being pushed. It is expected to reach Ironton with track about Sept. 1.

The snow tunnel which you mention between Silverton and Ouray on page 475 is fast melting away and will soon be a thing of the past. C. W. GIBBS, *Chief Engineer.*

Seattle, Lake Shore & Eastern.—Grading has been completed on the division 35 miles in length, between Spokane Falls and Davenport.—The difficulties with the Northern Pacific company are reported settled.

Mexican Pacific.—On Feb. 23, 1888, the President of Mexico confirmed a franchise for a line from the port of Mazatlan, State of Sinaloa, northwest, parallel with the coast line, to a connection with the Sonora Ry. at or near Guaymas. This franchise is a modification of the one granted for the Sinaloa and Durango line, which was signed July 5, 1886. The road will pass through Culiacan and Alamos. The franchise also includes a road from Culiacan or Mazatlan, through the States of Durango and Coahuila to the Rio Grande; also branches from either side of the lines, each branch not to exceed 62.14 miles in length, and the branches to be designated to the executive within 5 years from the date of signature of the franchise. From Culiacan to the port of Altalta a line 35 miles long is in operation, having been built under a concession granted by the Government of Sinaloa in August, 1880.

The time allowed for the surveys and construction is extended to date from Feb. 23, 1888, instead of July, 1886. The concession confers the right to construct and operate docks, wharves, telegraph lines, etc. The road is to be standard gauge; maximum grades, 4 per cent.; minimum curves, 325 ft. Rails, 60 lbs. per yard. The company formed to carry out this contract can issue bonds at not less than $15,000 nor more than $25,000 per kilometer, and can mortgage the line at a rate not exceeding $150,000 per kilometer. The Government subsidy is $8,000 per kilometer, in 6 per cent. bonds. At the end of 99 years the road and equipment are to become the property of the Government.

Portland & Willamette Valley.—The extension to a terminus at Jefferson Street, in the city of Portland, Ore., is completed and in operation. The next extension to be built by the company is a branch from Sheridan to Nestucca.

Oregonian.—The company has agreed to build a branch from West Scio to Scio, Ore., if the citizens will grade the line.

Oregon Ry. & Nav. Co.—The row over the joint lease of the Oregon Railway and Navigation Co. has culminated in the procuring of an injunction by BRAYTON IVES, WILLIAM L. BULL, and their friends restraining ELIJAH SMITH, SIDNEY DILLON, CHRISTOPHER MEYER, and their fellow-Directors of the Oregon Railway and Navigation Co. from doing almost everything.

BRAYTON IVES made the affidavit upon which the application for the injunction was based. Mr. IVES narrates the events which led to the execution last April of the joint lease of the Oregon Railway and Navigation Co. to the Northern Pacific Co., in consequence of an agreement entered into by the Northern Pacific, the Union Pacific, the Oregon Short Line and the Oregon Railway and Navigation Company. The joint lease would have gone into effect July 1, but some time before that a stockholder of the Oregon Railway and Navigation Company residing in Oregon got an injunction there against it on the ground that the Northern Pacific is a competing road, and that it is against the laws of Oregon for two competing railroads to be united by lease.

Mr. Ives seems to be of opinion that the Oregon injunction was inspired by Mr. Smith and the Union Pacific. Its main purpose, Mr. Ives asserts, was to enable Mr. Smith and associates to build branches of the Oregon Railway and Navigation Company extending into the territory which has been reserved exclusively for the Northern Pacific, thereby provoking a bitter railway war and counter-building on the part of the Northern Pacific.

Mr. IVES enumerates the things which he charges that Mr. SMITH and his fellows are doing in betrayal of their trust and in the interest of the Union Pacific, and Judge VAN BRUNT has enjoined them from doing so any more for the present at least. These are the building of a branch line from the town of Endicott, in Washington Territory, northeasterly, toward the Coeur d'Alene mountains; of a branch line from the town of Farrington on the border line between Washington Territory and Idaho, northeasterly, through Idaho Territory to the town of Rockford; the bridge now in course of construction across the Snake river at Riparia, Washington Territory, and branch lines over the old Texas and Ferry grade to the line of the Columbia & Palouse R. R. These are the specific injunctions; they are also generally enjoined from doing anything which looks to an invasion of the Northern Pacific's reserved territory until after the ratification of the joint lease, which Mr. IVES says will occur as soon as the Portland injunction is dissolved.—*N. Y. Times.*

San Francisco & Santa Cruz.—It is reported that this California project has been abandoned. F. T. NEWBERRY, of San Francisco, who made the surveys, thinks another company will soon take up the scheme.

Sonora, Sinaloa & Chihuahua.—This company has been organized to build a railroad from Deming, N. M. to Guaymas, Mexico, *via* Alamos. The charter members are H. B. FERGUSON and J. A. WILLIAMSON, Boston, Mass., JOHN A. LEE, Albuquerque, N. M., LOUIS HULLER, City of Mexico, GEO. H. SISSON, of San Francisco.

Billings, Clark's Fork & Cooke City.—Surveyors have begun work on the line of this Montana road which is to run from Billings, on the Northern Pacific, south into Wyoming.

Proposals Open.

Harvard Bridge.—Draw foundation and pier for the Harvard bridge across the Charles river, between Boston and Cambridge. Plans and specifications at the office of the City Engineer, Boston. The COMMISSIONERS OF HARVARD BRIDGE, City Hall, Boston, Mass. August 6.

Street Work.—WILLIAM STEYH, City Engineer, Burlington, Ia. August 6.

Bridge.—Iron highway bridge across Watab creek at Le Sauk, Minn. THE AUDITOR OF STEARNS CO., St. Cloud, Minn. August 7.

Bridge.—Wagon bridge over the "Big Slough", in the town of Drury, Rock Island Co., Ill., and the approaches thereto, to connect it with the road embankment at each end. The bridge will be 200 ft. long in three spans, the middle span 100 ft., and the end spans 50 ft. each. The substructure to be pile trestles of iron or wood; the length of piles required is 50 ft. or upwards. The superstructure may be of steel, iron or wood or a combination of the same. The width of roadway on the bridge to be 16 ft. said roadway to be 3 ft. above the line of highest water in the year 1888. The greatest depth of water when at that line is about 38 ft. The bottom of the stream consists of sand and mud.

As an alternative plan proposals will be received for filling the chasm with a solid embankment made of earth or combined with other material, wholly stopping the flow of water and turning it into another course; said embankment to be 20 ft. wide on top and sloping to the bottom at the rate of 1½ ft. horizontal to 1 ft. perpendicular. The top or roadbed to be finished level and at least 3 ft. above the highest water surface of 1888 after all subsidence and settling has taken place. DANIEL GORDON, County Supervisor, Mobile, Ill. Aug. 7.

Sewerage.—1st, The furnishing of all materials for, and the construction of storage reservoirs; 400 ft. of 24-in. × 36-in. brick sewer, and the furnishing and laying of 9,-

200 ft. of 12-in. cast-iron force main. 2d, The furnishing and replacing of one 2,000,000-gall. pump and one 1,000,000-gall. pump, with boilers and connections complete. 3d, The erection of chimney, coal shed and brick buildings for pumps and boilers. WALTER ADAMS, Chairman, Committee on Sewerage, Framingham, Mass. Aug. 7.

Dock Work.—Concrete wall, rip-rap and filling at Hoffman Id., New York Harbor; also dock at Quarantine Station, Staten Id. THE QUARANTINE COMMISSIONERS, 71 Broadway, New York City. Aug. 7.

Bridge Masonry.—Masonry and other work connected with the extension of the piers and abutments of the Connecticut river bridge between Holyoke and South Hadley. Plans and specifications at the office of E. A. ELLSWORTH, City Engineer, Holyoke. LEONARD CLARK, Joint Board of County Commissioners, Holyoke, Mass. August 7. (The specifications for this work will be found on advertising pages XX, XXII and XXIII).

Stand Pipe.—Separate bids for masonry foundations and iron stand-pipe 20 ft. x 120 ft. THE BOARD OF WATER COMMISSIONERS, Burlington, N. J. August 8.

Bridge.—Across Spanish bayou. O. N. WILDS, Natchez, Miss. August 8.

Train Shed.—Erecting complete; train shed 88 ft. x 500 ft., at Pittsburg, Pa. Plans and specifications at the Philadelphia office, and at the office of VICTOR WIERMAN, Assistant Engineer, P. R. R., Pittsburg, Pa. WILLIAM H. BROWN, Chief Engineer, Pennsylvania R.R., 233 So. 4th St., Philadelphia, Pa. August 8.

Canal Work.—Work at Lock No. 11 and Guard Lock No. 3, Oswego Canal. 2 bailing and draining; 10,000 cu. yds. excavation of earth; 250 cu. yds. excavation of rock; 750 cu. yds. excavation of masonry in lock walls; 7,100 cu. yds. embankment; 1,000 cu. yds. lining; 2,450 cu. yds. puddling; 75 cu. yds. slope wall; 200 cu. yds. vertical wall in cement; 435 cu. yds. vertical wall laid dry; 2,830 cu. yds. masonry in lock walls; 220 cu. yds. concrete; 10,500 ft. B. M. white oak in gates and miter sills; 8,750 ft. B. M. white oak timber; 9,950 ft. B. M. white pine timber; 103,000 ft. B. M. hemlock; 5,000 lin. ft. bearing piles delivered; 4,000 lin. ft. bearing piles driven; 120 lin. ft. snubbing posts set; 4,000 pounds wrought-iron; 300 pounds cast-iron; 4,500 pounds spikes and nails; 2 lead cement; 4 painting pair lock gates and railing; 8 composite valves and fixtures; 4 removing and replacing gates; 4 kerosene street lamps in place each; 2 machinery for drawing in boats. Deduct materials furnished by State; 280 cu. yds. vertical wall stone; 500 cu. yds. lock stone; 600 lin. ft. piles. JAMES SHANAHAN, Superintendent of Public Works, Albany, N. Y. August 8.

Street Work.—Grading and curbing. WALTER P. RICE, City Engineer, Cleveland, O. August 9.

Water-Works.—For Pawnee City. Separate bids for tubular wells and for pumping machinery. A. A. RICHARDSON, of Lincoln, Neb., Consulting Engineer. W. B. BULL, Mayor, Pawnee City, Neb. August 9.

Street Work.—About 15,000 lin. ft. of straight curbing. THE BOARD OF PUBLIC WORKS, Providence, R. I. August 9.

Cruiser.—Materials for the construction of the U. S. armored cruiser *Maine*. THE SECRETARY OF THE NAVY, Navy Department, Washington, D. C. August 10.

Jail.—Remodeling the jail and building new iron cells, etc. F. C. LONG, Jackson, Tenn. August 10.

Street Work.—Regulating, trap block paving and granite block paving. THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers St., New York City. August 14.

Boring for Water.—Boring and testing for water on North Brother Id. THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers St., New York City. August 14.

City Bonds.—Bonds for $500 and $1,000 to the amount of $150,000. A. C. BOTKIN, City Clerk, Helena, Mont. August 15.

Retaining Walls.—For the new railway terminal facilities. Excavating soft material, refilling with sand or gravel, and building walls for the extension of the Woonasquatucket and Moshassuck rivers through the Cove basin. The work to be done comprises approximately: 124,900 cu. yds. excavation; 83,950 cu. yds. sand or gravel filling; 1,528 cu. yds. rip-rap; 210 cu. yds. concrete; 800 spruce piles; 18,250 ft. B. M. spruce lumber; 8,460 cu. yds. rubble masonry in cement; 2,825 cu. yds. rubble masonry laid dry; 3,333 lin. ft. of coping to reset; 2,003 lin. ft. of railing to reset. S. M. GRAY, City Engineer, Providence, R. I. August 23.

Bridge.—Iron bridge; 308 ft. long; 2 spans of 166 ft. each, and 1 of 66 ft.; roadway 20 ft. wide; 2 walks 8 ft. wide; capacity 100 lbs., factor 4. Bidders to furnish plans. HORATIO PEARSON, Auditor, Troy, Miami Co., O. August 28.

Contracting.

Street Railway Surveys.—A street railway is to be built at Fond du Lac, Wis., and an engineer is wanted to make surveys, plans and profile, and estimate.

Street Railways.—*Chicago, Ill.*—E. D. Smith & Co., of Pittsburg, Pa., have the contract for the construction of the cable road on the West Side.

St. Joseph, Mo.—The St. Louis Electric Power Co. has the contract for the construction of the Wyatt Park street railway. The Sprague electric system will be adopted.

Steam Riveting Machines.—W. B. Pollock & Co., of Youngstown, O., want to purchase steam riveters.

Stone Crusher.—At Boston, Mass., the Superintendent of Streets has been directed to purchase a street stone crusher for use in West Roxbury.

Track Material.—Track material, new or second hand, for 6 to 7 miles of track, is wanted by EDWARD SHELLEY, Kingston, Tenn. Standard gauge; 56 lb. rails, splice bars, bolts, spikes, etc., etc.

The Pullman Palace Car Co., is doing considerable work in street cars. Among contracts now in hand are 32 open cars for Minneapolis, Minn.; 10 steam motor cars, 18 open and several closed cars for Topeka, Kan.; 50 cable grip cars for Pittsburg, Pa.; 2 cars for Sheboygan, Wis., and 20 cars for the electric railway at Omaha, Neb.

Railway in Central America.—An important railway project in Central America is expected to be undertaken shortly. The concession for the line, about 150 miles long, is held by a company, and arrangements will probably be made with financial men, or with some large contracting firm, for the construction and equipment of the road. A construction company may be organized.

Street Work.—The following proposals for paving Main St., Zanesville, O., have been received by the Street Committee: J. Burns & Co.; excavation, 40 cts. per sq. yd.; paving, complete, $1.20 per sq. yd; J. M. Todd, Wheeling; W. Va., 80 cts., $1.18; G. B. Boren, Steubenville, O., 37 cts. $1.49½; Fink & Henderson, Youngstown, O., 33⅓ cts.; $1.37½; C. Lenhart, Wheeling, W. Va., $1.50 complete; T. B. Townsend, 80 cts., $1.17. The contract was awarded to J. Burns & Co., and the work will amount to $15,550.

Street Work.—The following were the lowest bids for work received July 27 by C. D. JACOB, Mayor, Louisville, Ky.: Twenty-first St.; Gleason & Gosnell: 20 cts., excavation; 62 cts., curbing; $3, corner stones; $11.60, paving; $2.75, crossings.——Churchill St.; Gleason & Gosnell: 20 cts., excavation; 70 cts., curbing; $3, corner stones; $11.90, paving; $3, footways.——Thirty-sixth St.; Gleason & Gosnell: 25 cts., excavation; 80 cts., curbing; $3, corner stone; $12.45 paving; $3, footways.——Black stone alley; C. P. Selvage; $27.50, paving.——Alley; E. Stringle: $23, paving.——Hancock St.; E. Stringle; 20 cts., excavation; 68 cts., curbing; $11, paving; $3, footways.——Breckenridge St.; Humpich & Broyer: 15 cts., excavation; 15 cts., fill.; 68 cts., curbing; $11.50 paving; $3, footways.

Railway.—Messrs. Keller & Crosson, of Lancaster, Pa., have been awarded the contract for building the Tapeworm Railroad, running from Gettysburg to Blue Ridge summit, a point on the Western Maryland Railroad. It is 15 miles in length and was originally projected by THADDEUS STEVENS in 1837. The above named contractors have sublet two miles of their work together with a tunnel 500 ft. in length to Messrs. Hugh Keogh, of Lancaster, and P. P. Reilly, of Altoona. They will begin work immediately, having purchased an extensive equipment.

Street Work.—*Brooklyn, N. Y.*—The following proposals for cobblestone paving have been received by JOHN P. ADAMS, Commissioner of City Works: on 13th St.; Patrick O'Hara, $7.66 per lin. ft.; John Hart, $5.92 per lin. ft.; Maurice F. Hickey, $4.29. On Norman Ave.; John Hart, $4.67; Henry Mogk, $4.49. On Hancock St.; Henry Mogk, $4.99; John Hickey, $4.35; H. A. Nolan, $3.65. For flagging sidewalks proposals were received from Charles Hart at 23 cts. per sq. ft.

Albany, N. Y.—The contract for improving Allen St. has been awarded by the Board of Contract & Apportionment to Jacob Holler, at the following prices: excavation, 10 cts. per cu. yd.; filling, 9 cts. per cu. yd.; 4 ft. culverts, $4.50 per lin. ft.; 3 ft. culverts, $3.50 per lin. ft.; 15-in. pipe, 85 cts. per lin. ft.; 12-in. pipe, 80 cts per lin. ft.; rubble masonry, $4.50 per cu. yd.——The contract for the improvement of Beaverwyck Park was awarded to Patrick H. Reilly for $1,385, and 40 cts. per cu. yd. for extra excavation and filling.

Lancaster, Pa.—The following proposals have been received by S. C. SLAYMAKER, City Engineer: Grading Franklin St.; J. F. Stauffer, excavation, 29⅔ cts. per cu. yd.; masonry, $3 per cu. yd.; total, $2,050: Kitch & Smith, 18 cts. for excavation, $336 for masonry complete. Henry Shaub, earth and rock excavation, 17 and 50 cts.; John Musser, 15½ cts. for excavation, $3.50 for masonry, or $1,400 and $125 totals; John Kendig, earth and rock excavation, 28 and 50 cts.; masonry, $3.95——Grading Clay St.; Kitch & Smith, 17 cts. per cu. yd. for excavation; John Musser, 16 cts. or $570 total.——Grading Fremont, Union and Juniata Streets; Pontz & Miller, 14½, 15 and 14½ cts.; Francis Aucamp, 17, 25 and 18 cts.; rock 40 cts.; Henry Shaub, 18, 18 and 17 cts., rock 50 cts.; Frank Hinder, 38 cts. each; J. F. Stauffer, 48 cts.; for Juniata St.; Kitch & Smith, 30¾ cts. for Juniata St.; C. W. Schwebel, $877.20 for Juniata St. complete.

Springfield, O.—Proposals have been received ranging as follows: curb and gutter, 68 to 79 cts. per lin. ft.; brick paving, 53 to 65 cts. per sq. yd.; earth excavation and filling, 90 cts. to 90 cts. per cu. yd.; graveling, 35 to 97½ cts. per cu. yd.

Bridge.—The New York Central & Hudson River R. R. Co. has awarded to the Hilton Bridge Co., of Albany, N. Y., the contract for the Normans Kill bridge, on the Albany branch of the West Shore road. The bridge is a lattice structure, 80 ft. span, single track, weighing 51 lbs.

Granite Blocks.—At Johnston, R. I., the contract for granite blocks for paving Plainfield St. has been awarded to the Chapman Granite Works, of Westerly, R.I., at $1.65 per sq. yd., measured after the pavement is laid. The blocks are to be not less than 10 ins., nor more than 14 ins. long, 3½ ins. to 4¾ ins. wide, and 7 ins. to 8 ins. deep. They are to be dressed so as to form, when laid, joints not exceeding 1 in. top and bottom; end joints not to exceed ½ in.

The West End Street Railway Co., Boston, Mass., is said to have the largest street railway combination in the world, having about 212 miles of track and over 8,000 horses; 10 per cent. of the horses are counted as being off duty from illness, sprains, shoeing or other causes, and the balance of the horses average about 12 miles a day. A car day is estimated at 10 to 11 hours, and from 45 to 50 miles, and 8 horses are allowed as the motive power.

Pipe and Flexible Joints.—The following proposals for 3,425 ft. of 6-in. cast-iron water pipe, with flexible joints, to be laid between Long and Moon islands, Boston harbor, were opened July 27 by the Water Board, Boston, Mass: Townsend & Davidson, Boston, $2.90 per lin ft., Thos, F. Maney & Co., Boston, $3.75; John F. Ward, Jersey City, N. J., $4.30; Metropolitan Construction Co., Boston, $4.45. The contract was awarded to Townsend & Davidson.

Steel.—The Navy Department has awarded contracts as follows for steel for the armored battle ship *Texas*, to be built at Norfolk, Va.: Park Bros. & Co., Pittsburg, 920 tons of steel plates, $66,779; Carnegie, Phipps & Co., Pittsburg, 503 tons of shapes, $43,266, and 100 tons of rivets, $8,601; Standard Steel Casting Co., Thurlow, Pa., 120 tons of steel castings, $41,664.

Asphalt Paving.—*Brooklyn, N. Y.*—Cranford & Valentine have been given by City Works Commissioner ADAMS the contract for re-covering such streets in the city as are paved with asphalt and are in need of repair. The material to be used in the work is Trinidad asphalt and the price to be paid is $1.80 per sq. yd. Cranford & Valentine are also required by the terms of the contract to keep the re-covered parts of the streets in repair for five years. The contract was let without competition because of patent rights held by the contractors.

Drainage, Elevators, Etc.—The Park Commissioners, New York City, have awarded the following contracts: Joseph Moore, receiving basins and inlets for the drainage of Morningside park, $4,893. McAdams & Cartwright, passenger and freight elevator in the extension to the Metropolitan Museum of Art, $5,300. James Slattery, excavation and removal of earth and rock from the site of the enlargement of the Metropolitan Museum of Art, $17,500. Joseph Moore, renewing the flooring of the Third Ave. bridge over the Harlem river, $8,000.

Dams.—*Holyoke, Mass.*—Owing to the fact that a certain statute law of the State, relative to first obtaining the consent of the County Commissioners before proceeding to build any reservoir dam, having been overlooked, the bids advertised for recently for the building of a dam were returned unopened. This formality has now been attended to and the necessary approval obtained. New bids will at once be called for. E. A. ELLSWORTH, City Engineer.

Naugatuck, Conn.—The Naugatuck Water Co. has awarded to Franklin A. Snow, of Providence, R. I., the contract for the construction of a distributing reservoir dam and appurtenances. T. H. MCKENZIE, Chief Engineer.

Dredging.—The following proprosals for dredging in the Hudson river have been received by J. SHANAHAN, Superintendent of Public Works: For 600 cu. yds. at Stone House; Lane & Brumelkamp, Syracuse, 23 cts.; Morris & Cummings, New York, 22 cts.; E. M. Payn Albany, 19 cts.; Charles Brown, Mohawk, 16½ cts.; P. W. Myers, Albany, 16½ cts. Contract awarded to P. W. Myers.——For 18,000 cu. yds. at New Baltimore light; Lane & Brumelkamp, 23 cts.; Morris & Campbell, 23 cts.; E. M. Payn, 18 cts.; P. W. Myers, 14 cts. Contract awarded to P. W. Myers.——For 25,000 cu. yds. at Mull's light; Lane & Brumelkamp, 22 cts.; Morris & Campbell, 22 cts.; Charles Brown, 17½ cts.; P. W. Myers, 16 cts.; E. M. Payn 15.9 cts. Contracts awarded to E. M. Payn.

City Work.—The Public Improvements Committee, Kansas City, Mo., has awarded contracts as follows: *Curbing*; E. J. Oberly, 65 cts. and 15 cts. per lin. ft. for new curb and resetting old curb; A. Keating, 65 and 69 cts. for new curb, and 15 cts. for resetting.——*Grading*; G. K. White, 14½, 24 and 35 cts. for earth, 65 cts, for rock; Patrick O'Donnell 16 and 47 cts. for earth and rock; O'Flaherty & Crowley, 17¾ cts.; T. F. Ryan, 24 cts. for embankment, 80 cts. for rock excavation.——*Cedar block paving*; A. J. McBean & Co., $1.37, $1.41, $1.47 and $1.87 per sq. yd.; Andrew Jaicks, $1.43.——*Sewer*; Thomas Fisher, 385 ft. of 21-in. pipe, $1.10 per ft.; one manhole, $40.——*Sidewalks* (second class); R. D. Glenn, 26, 27, 27½ 28, and 29 cts. per lin. ft. Thomas W. Fokes, 26 and 28 cts James Armstrong, 25, 25½, 26 and 30 cts.

Building.—The contract for the Post Office and Federal Building, at Brooklyn, N. Y., has been awarded to E. F. Gabel, of Chicago, at $623,834.

Pumping Station.—The Louisville Water Co., of Louisville, Ky., is at work on its new pumping station. The original contractors threw up the contract and the company readvertised for bids for the construction of the new works; several bids were received, but after examination, the figures of all were considered too high, they were therefore all rejected and the company undertook the work for itself. Contracts have been let to the Belknap & Dumesnil Stone Co. for about 3,000 cu. yds. of dressed stone, and to Frank Akers for 3,000,000 brick. The main portion of the work,—that is, the foundations and substructure up to the main floor,—will be finished this season, and work completed next season. The company thinks it can do the work for less money than the amount of any of the contractor's bids received. Mr. CHAS. HERMANY is the engineer.

Bridge.—The following proposals have been received by the County Commissioners, at Lancaster, Pa., for the construction of the bridge, 60 ft. span, over Coon creek, at Kinseyville, Little Britain township. The bridge companies presented their own plans, while the other bids were on the Commissioners' plans: Mt. Vernon Bridge Co., Mt. Vernon, O., $12.50 per lin. ft.; Columbia Bridge Co., Dayton, O., $750.88, $937, $1,040; King Iron Bridge & Mfg. Co., Cleveland, O., $832; Pittsburg Bridge Co., Pittsburg, Pa., $785; Dean & Westbrook, New York, $877, $843; Wrought Iron Bridge Co., Canton, O., $882, $950; E. McMellen, $1,597 for original plan, and $1,747 for commissioners' plan; Jacob Kauffman, $1,670; Geo. E. Jones, $1,689; J. F. Stauffer, $1,950; Frank Follinger, $1,595; Milton Walker, $645 for masonry, $1,123 for superstructure; A. S. Urban, $1,950 complete, $1,225 for superstructure; Samuel Stauffer, York, Pa., $785, $650, $575, $746 and $686; Davis Kitch and John R. Smith, masonry, $3.25 per perch with lime and sand, or $3.66 with cement; Joseph Licht, masonry, $2.85; B. F. Worth, masonry, $2.47; Joseph Kreckel, masonry, $3.25; Samuel Conrad and James R. Rea, masonry, $3.30. The contract for the superstructure was awarded to the Columbia Bridge Co., and for the masonry to B. F. Worth, of Providence township.

Sewers.—***Montgomery, Ala.***—The following proposals have been received by J. G. WILLIAMSON, City Engineer: J. A. Gaboury, Montgomery, $57,348.53; Clements Bros., Cleveland, O., $63,650.23; J. H. Haney, Little Rock, Ark.: $69,212.48; Howland & Ellis, Boston, Mass., $76,045.53; Figh & Williams, Montgomery, $81,694.79. The contract was awarded to J. A. Gaboury at the following prices: 24 × 36, $2 per ft.; 16 × 24, $1.60; 18-in., $1.40; 15-in., $1.10; 12-in., $1; 10-in., 95 cts.; 8-in., 73 cts.; manholes, $42.75.

Wallingford, Conn.—The following proposals for the construction of about a mile of sewers and appurtenances have been received by H. L. DAVIS, Borough Engineer: J. H. McCormack, Wallingford, $7,566.22; Jacoby & Madden, Bridgeport, $7,631.85; M. L. Austin, New Britain, $8,321.20; Everson & Liddle, Yonkers, N. Y., $8,395.61; Francis Leonard, Norwalk, $8,003; H. P. McTague, Philadelphia, Pa., $8,798.97; E. McManus, Waterbury, $8,844.68; Smith & Brodie, Long Island City, N. Y., $8,872.10; T. Wm. Harris & Co., New York, $8,872.73; Robt. Fenton, Willimantic, $9,775.32; Dodge & Devanny, Pittsfield, Mass., $10,359.24; Matthew Kehoe, New Haven, $10,389.52; Henry Kellner, Waterbury, $10,435.58; L. W. Burt, Hartford, $10,608.70; A. Brazos & Sons, Middletown, $10,815.10. The contract was awarded to J. H. McCormack. The appropriation for the work was $8,000.

Lancaster, Pa.—The following proposals have been received by S. C. SLAYMAKER, City Engineer: For 1,140 ft. of 36-in. sewer; J. F. Stauffer, $1,650 for sewer, $400 for inlets and manholes; Kitch & Smith, $1,459.80, $390.25 Chas. Schwebel, $1,385, $500; Riley & Hinder, $2,058 total; Bernard Malone, $2,166 total.——For 2,063 ft. of 36-in. sewer; J. F. Stauffer, $3,064.50 for sewer, $655.50 for inlets and manholes; Kitch & Smith, $2,630, $595; Frank Hinder; $4,437.70 total; Bernard Malone, $4.136 total; John Kendig, $3,738, $669.

Nashville, Tenn.—The contract for the Mallory St. sewer has been awarded to G.H. Harris & Co., for $5,607.60

Paving Material.—The following proposals have been received by the Engineer Commissioner, Washington, D. C: Ackers & Co., Washington, D.C., 7,000 ft. of 5x20 curb, 82½ cts. per lin. ft. S. Emery, Washington, D.C., 15,000 ft. of 6x20 granite curb, 95 cts. per lin. ft.; 25,000 ft. of 8x8, 90 cts.; 200 ft. each of 6x20 and 8x8 granite circular curb, $1.50. Brandywine Granite Co., Wilmington, Del., 15,000 ft. of 6x20 granite curb, 95 cts. per lin. ft.; 25,000 ft. of 8x8, 87 cts.; 200 ft. each of 6x20 and 8x8 granite circular curb, $1.50. Virginia Slate Granite Co., Granite, Chesterfield Co., Va., 25,000 lin. ft. of 8x8 granite curb, 95 cts. per lin. ft.; 700,000 granite paving blocks, $43 per 1,000. Washington Brick Machine Co., Washington, D. C., 2,500,000 paving bricks, $8.93 per 1,000; 200,000 arch bricks, $7.23 per 1,000. Maryland Pavement Co., Baltimore, Md., 200,000 asphalt blocks, $71 per 1,000. Hastings Paving Co., New York City, 150,000 asphalt tile, $60 per 1,000. Richmond Granite Co., 612 Chestnut St., Philadelphia, Pa., 700,000 granite paving blocks, $42 per 1,000. Booth Bros., 65 Bank St., New York, 700,000 granite paving blocks, $39.90 to $43.75 per 1,000.

Bridges & Canals.

The California Bridge Co. has been incorporated at Oakland, Cal., by A. W. BURRELL, D. H. WARD, C. C. COTTER, EGBERT JUDSON and H. H. BURRELL. Capital stock, $150,000.

Florida Canal.—Work is progressing on the East Coast Canal, from St. Augustine to Lake Worth, in Dade Co. The company talks of buying new dredges.

The Deep Water Convention, to consider the question of establishing a deep water port on the Gulf coast, in Texas, will be held at Denver, Col., Aug. 28. Delegates are expected from other western States and Territories.

Stone Arch Bridge.—At Buffalo, N.Y., a stone bridge with 3 arches of about 20 ft. span, across Scajaquada creek, will soon be completed. The contractor is Thomas Dark, and the cost is estimated at about $1 ,000.

Pontoon Bridge.—The President has signed the bill authorizing the Randolph & Kansas City Bridge Co. to construct a pontoon bridge across the Missouri river between Jackson and Clay counties. The bridge will be similar to the one at Prairie du Chien, Wis., will be strong enough for a street car line, and will cost about $125,000.

Ship Canal.—It is reported that surveys have been made for a ship canal from the San Joaquin river to Fresno, Cal. It will be of sufficient size to enable stern-wheel steamers to run through from San Francisco. The estimated cost is $1,000,000.

Harlem River Bridges.—The Park Commissioners, New York City, have decided that no more drawbridges shall be built across the Harlem river. The report of Gen. JOHN NEWTON, EDGAR B. VAN WINKLE, THOMAS C. CLARKE, and GEORGE W. MCNULTY, the engineers appointed to consider the relative advantages of drawbridges, high-span bridges, or tunnels as a means of communication across the river, have reported in favor of tunnels in place of bridges, and that a tunnel, from a point at or near Seventh Ave., could be constructed for $2,000,000.

Jackson Street Drawbridge.—The new drawbridge at Jackson St., Chicago, will be completed in about a month. It is of steel, 280 ft. long; built of steel and operated by steam; there will be two 21 ft. roadways, and two 7 ft. sidewalks. No street railway is allowed to cross. The cost of the structure is given below:

West of River—		
Masonry, substructure and approaches		*$44,465
Superstructure		† 64,600
Miscellaneous, sidewalks, etc		23,600
Total		$132,665
*Of this item the railroad companies pay	$ 9 139	
†All paid for by railroad companies	64,600	
Total paid for by railroad companies		$ 73,739
Paid for by city		58,926
East of River—		
Masonry, substructure and approaches		$ 19,600
One span of viaduct		11,100
Miscellaneous, sidewalks, etc		18.144
Total		$ 48,844
For center pier, abutment, and protection		49,806
Superstructure		76,500
Machinery for operating		4,526
Miscellaneous (approximate)		6,000
Total		$136,832
Total cost to city		$244,602

A Canadian Canal at "The Soo."—It is reported from Ottawa that in consequence of threats of the United States authorities to discriminate against British shipping using the Sault Ste. Marie canal, the Dominion Government has resolved to proceed at once to build a canal on the Canadian side. Surveys and plans have been in progress for some time and are now well advanced.

Bridge Notes.—***North Adams, Mass.***—A stone arch will be built to replace the bridge on the Blackinton road at Greylock.

Suffield, Conn.—The iron bridge on the main road to Windsor Locks has been delayed, but work is now approaching completion.

Lynchburg, Va.—The Norfolk & Western R. R. Co. will build a new iron bridge over the canal.

Rowlesburg, W. Va.—The Baltimore & Ohio R. R. Co. will build a new iron bridge over the Cheat river.

Macon, Ga.—The Georgia Central R. R. Co. will build a new iron bridge over the Ocmulgee river.

Saybrook, Ill.—The Board of Village Trustees and the Highway Commissioners of Cheney's Grove township, are building a new bridge across the Sangamon river. The cost of the bridge itself is $600, exclusive of approaches, etc.

Waupaca, Wis.—The town of Fremont has raised $1,800 for the bridge across the Wolf river at Waupaca. The bridge will cost $5,000, and work will be commenced at once.

Armourdale, Kan.—The county bridge on the southern road has been condemned by the County Commissioners, and a new iron structure is to be built at a cost of $25,000 or $30,000. Proposals will be received and contracts awarded shortly.

Pasco, Wash. Ty.—The Columbia River bridge, which is 2,700 ft. long, is completed. Assistant Engineer HUSON, of the Northern Pacific R. R., had charge of the work.

Eagle Pass, Tex.—The Rio Grande Bridge & Tramway Co. has placed its bonds, and will proceed with the construction of the bridge.

St., Francis, Que.—The Quebec Central Ry. Co. is building a new iron bridge over the St. Francis river.

WATER.

Sewerage.—***New Bedford, Mass.***—The City Council has made a special appropriation of $2,000 for the general sewers account.

Newport, R. I.—Work has now been in progress on the sewer tunnel for about three months, and the work is approaching completion. The contract aggregates about 2,000 ft. of tunnel, and other contracts have been made for branches to certain estates. A. C. Douglas is the contractor.

Greenbush, N. Y.—The engineers have reported to the sewer commissioners that $47,741.86 had been expended in constructing 4 miles 3,456 ft. of completed sewer. They estimate that $16,144.80 will be needed to complete the system, making a total of $64,886.66, or $10,000 less than the amount appropriated.

Asheville, N. C.—The question of bonding the city for $100,000 for sewerage having been carried, the work of establishing a complete system will be commenced at once.

Helena, Mont.—The recent vote on the issue of $150,000 for a sewerage system has been carried, but the vote taken was very small. The result was 225 for, and 43 against.

Tacoma, Wash. Ty.—An ordinance has been introduced to authorize the construction of a system of sewers in accordance with plans prepared by Major SEARS, of Portland, Ore.

St. Lambert, Que.—J. M. WALBANK has presented to the Muncipal Council plans for a system of sewers, in which special provision is made for floods. The large sewers would be paid for by the municipality, and the smaller ones by the property owners.

Water-Works.—***Maine.*** Farmington. The village corporation is again considering the question of a water supply; also of an electric light system.

Massachusetts.—Williamstown. The works will be built by John J. Morse, of North Adams. The reservoir will be 200 ft. square and 10 ft. deep, and will be supplied by a spring near the base of East mountain. Work is to be completed by October.——Brookfield. The reservoir dam is completed.——Malden. The committee report, recommending that the water supply be taken from wells in Eatons meadows, has been accepted.——Great Barrington. The Berkshire Heights Water Co. is laying 2,300 ft. of pipe from the reservoir to the village.——Easthampton. The water committee has located and purchased the site for the dam. City Engineer STRONG, of Northampton, will make surveys, plans and estimates, and proposals will soon be advertised for.

Rhode Island.—Newport. The Newport Water-Works will lay pipes across the harbor, alongside the sewer pipes, to supply the torpedo station with water.——Westerly. The pipe system will be extended by 2,000 ft. of 6-in. pipe; the pipe has been delivered.

Connecticut.—Stonington. The reservoir site has been selected, and is 185 ft. above tide water. Water will be pumped from a pond on Copps brook, 3 miles from the town and 1 mile from the reservoir, by a 50 H. P. turbine and a 50 H. P. engine and boiler; the pond has a storage capacity of 30,000,000 galls., and 1,000,000 galls. per day will be pumped to the reservoir by the turbine or the engine. Mystic will also be supplied. FRANK C. KIMBALL is the engineer.——Windsor Locks. The water-works will probably be completed by November.

New York.—Sandy Hill. The works are expected to be in operation by September. The fixed charge for the 45 hydrants is $2,500 per annum.——Northville. A private water supply has been introduced through Bridge St. by RAY HUBBELL. The water is pumped by a wind engine from springs to the factory.——Green Island. The new aqueduct and well on Gravel island are completed and pipes will be laid to the pumping station. The water is obtained from springs and flows 150 ft. through a 6-ft. aqueduct to the well, which is 20 ft. deep and 9½ ft. diameter.——Amsterdam. Water mains are being laid on the boulevard.——Fulton. The President of the village trustees, the finance committee and the village attorney have been appointed a committee to prepare a contract with the water company.

Pennsylvania.—Braddock. Contractor Weaver began work on the improvements July 23. A new receiving well is to be dug and an inlet pipe laid 500 ft. into the river. The work will cost between $9,000 and $10,000.——Reading. At the meeting of the council on July 30 an ordinance was introduced appropriating $150,000 to bring the waters of the Maiden creek into the city. The point at which the stream is to be tapped is 7 miles from th

city and pipes are to be laid capable of carrying 8,000,000 galls. daily.

Tennessee.—Tullahoma. Mr. SHELNUTT, representing the Shelnutt Water Engine Co., of Louisville, Ky., proposes to put an engine near the big spring and pump water in a main to an elevated reservoir and furnish water from this reservoir, near the creek at the west crossing, for a small sum of money. At a special meeting of the Board, Mr. SHELNUTT's proposition to furnish the city with an abundance of water was considered favorably, and a committee selected to look into the plans and see if they are entirely adequate to the wants of the city. It is probably that a vote may be ordered at a general election.—Bristol. The water-works to be built by W. W. Taylor, of Philadelphia, Pa., are to be completed by December. Goodson, Va., across the line, will probably agree to the same terms, and be supplied by an extension of the works.—Chattanooga. The Spring Lake Water Co. has been incorporated by R. MORRISON and others to furnish a water supply for the suburbs.—Shelbyville. Water-works are needed.

Illinois.—Jacksonville.—The City Council has passed an ordinance authorizing the Board of Water Commissioners to expend $7,000 in sinking an artesian well, near the pumping works, to ascertain if water can be obtained in sufficient quantity by that means.

Kansas.—Oberlin. It is proposed to issue bonds for $30,000 for water-works and an electric light system.

Nebraska.—Mason.—The vote on the issue of bonds for a system of water-works was carried July 21.

Colorado.—Del Norte. It is proposed to put in water-works and electric light at a cost of $40,000.—Colorado Springs. The Austin Bluffs Land & Town Co. has bought water-rights on West Monument creek, 9 miles northwest of the city, and will lay pipes to its property adjoining the city; it also proposes to supply water to the northern portion of the city if the Council will grant a franchise.—Glenwood Springs. The water-works are expected to be completed by September. MASON W. MATHER is the engineer.

Montana.—Butte. The water question is being agitated. At a recent meeting of the city council, Mayor HAMILTON made a long address on the subject, and advocated a plan whereby the city would build and own its own water-works.

Washington Territory.—Palouse City. The city is putting in a system of water-works at a cost of about $8,000.

Texas.—Rockdale. Water-works are to be built.—Waxahachie. The city will issue bonds for $30,000 for water-works.—Waco. The city is now without a water supply for fire protection, except by the courtesy of the Waco Water Co. There is a disagreement between the water company and a portion of the City Council, which has hitherto prevented a renewal of contract. At the request of Mayor HINCHMAN, President C. W. WHITE, of the Waco Water Co., has submitted five proposals for a contract, which will be considered by the Council as a committee of the whole on water supply.

Water Power in Maine.—At Norway, Me., it is proposed to utilize the lake for water power. The outlet is through meadow land, which is flooded during a part of the year. By means of a dam and some excavation a large reservoir could be obtained, which would furnish water for the mills at the lower falls even in the dry season.

Chicago, Ill.—Recently one of the engines at the canal pumping works was disabled, the suction pipe becoming choked with driftwood. The damage was repaired as soon as possible, but not before the current of the river had set in to the lake. The capacity of the works is inadequate in times of freshets or heavy rains, and Mayor ROCHE says that the evil can only be cured by the construction of a large canal from Chicago to Lockport. Additional legislation is necessary, and a bill is now being prepared; the Roche-Winston bill passed by the last Legislature not being extensive enough.

Parkersburg, W. Va.—The committee appointed to investigate the condition of the water-works and their capacity, has reported that the engines pumped regularly 400,000 galls. per 12 hours, running at the rate of 17 strokes per minute, and that if the engines were run at 20 strokes, as was claimed would be done, the concussion would injure the pump house. During the 10 days in June, during which the committee tested the amount of water pumped, the engines pumped 2,999,998 galls. into the tanks, which was practically equal to the test made by the contractors.

Buffalo, N. Y.—Recently, City Chemist VANDENBERGH, at the request of City Engineer MANN, made an analysis of water taken from the river at the Bird Island pier and at the inlet pier. The analyses are as follows:

Bird Island Pier—Free ammonia, 0.0008; albuminoid, 0.01; chlorine, 0.7; hardness, 13.4.
Inlet Pier—Free ammonia, 0.001; albuminoid, 0.008; chlorine, 0.8; hardness, 9.6.

The City Chemist says: "That from mid stream is perceptibly better, but we cannot consistently urge haste on account of poor water. That now being pumped is a very fair water, better than is supplied to most cities."

Jamestown, R. I.—At a recent meeting of the incorporators of the Jamestown Light & Water Co., the following officers were elected: President, GEO. C. CARR; Treasurer, P. TUCKER; Secretary, DANIEL WATSON. The charter was granted by the Legislature in May.

Philadelphia Water.—At Philadelphia, Pa., the people in the central part of the city have been troubled by foul water, the odor of which is said to have been extremely bad. Chief Engineer OGDEN had a theory that someone who had an artesian well, the water of which was unfit for use, might be permitting the same water to flow back in the city's pipes. This might be done accidentally, where the pressure from the well was greater than that from the reservoir, or it might be done on purpose. He said he had come across artesian well water that smelt very much like the foul stuff that had been sent to him. The suggestion that dead fish might be the cause, was not considered to have any foundation.

Peoria, Ill.—Messrs. Moffett, Hodgkins & Clarke, of Watertown, N. Y., have made a proposition to put in a system of water-works, supplied from a reservoir. The company has asked the city to appoint a committee, and offers, after a conference with said committee, to undertake, at its own expense, the making of plans, investigations and experiments, necessary to develop a new source of supply, yielding pure, wholesome water; and also the making of plans, maps and specifications for the enlargement of the present water system, including the enlargement and extension of mains, reservoir, new pumping station, etc.; and upon the completion of the same will submit a definite proposition to the committee.

San Francisco, Cal.—President C. W. HOWARD, of the Spring Valley Water Works Co., in his annual report states that when completed according to the present plans the works will be quite adequate to supply with water a population of 500,000. The company is now using over 6,000 meters, a large increase above last year, and calculations are made for a future daily increase of about thirty-five. The receipts for the last year ($1,375,000) were $16,808 less than the expenditures. The floating debt of the company during the last year increased $1,314,000, and the total indebtedness $2,214,000. On account of the necessarily large expenditure for the tunnel in San Mateo Co., the President stated that a proposition to increase the capital stock would be made, but he advised the postponement of the matter till a larger personal representation of stock could be had.

Irrigation.—*California.*—Work is soon to be resumed on the tunnel which is to tap Eagle Lake, Lassen Co. The tunnel is being run by P. N. MARKER, of Nevada, and Capt. C. A. MERRILL, of California. The lake will give a flow of 780,000,000 galls. per 24 hours, and will irrigate 150,000, acres of land on the borders of Honey Lake valley.—The plant and water rights of the Dutch Hill Mining Co., in Plumas Co., have been sold, and the plant will be used for irrigation purposes.

Arizona.—The Committee on Indian Affairs, at Washington, has granted the Citron Water Co. the right of way across the Papaso Indian Reservation for an irrigation canal. The work is to be completed in 2 years.

Texas.—A. M. BRUIN, of Laredo, has purchased two pulsometer pumps, and a 50 H. P. boiler, for the purpose of pumping water to irrigate his farm 20 miles from the city. The result of irrigation by steam pumps will be watched with interest.

Drainage in Illinois.—There has heretofore been a marsh of some 200,000 acres in extent on the west side of Mason Co., Ill., which lies along the Illinois river, that stream making the western boundary. This marsh, since the settlement of the State, has been a great duck and game hunting ground, though considerable of a nuisance to the farmers living on its borders. This marsh has recently been drained by the Mason County Ditch Co., consisting of the farmers owning the adjoining lands and the outside proprietors of the marsh lands. The main ditch is 60 ft. wide at the top, 40 at the bottom, and 8 ft. deep. It is fifteen miles long, has a fall of 4 ft. to the mile, and drains with its laterals, which are 30 ft. wide at top, 15 ft. at bottom, and with a depth to correspond with the main ditch, from 200,000 to 300,000 acres. The cost of the whole is estimated to be $200,000. The earth removed is sand and clay mixed, and offers little resistance to the machinery. The dredge doing the work floats in the water of the ditch and makes 100 ft. progress every day. The assessed cost on some of the drained land will ultimately amount to $25 per acre, and thence grading down to a trivial sum.

The work has been in progress for several years, and meantime the land drained has produced surprising crops of wheat and corn. The past year—a year of severe drouth—matters have not progressed as favorably in respect to crops, thousands of acres of corn having been lost by "firing," in consequence of the sudden withdrawal of the usual moisture. The thoughtful among the projectors of the scheme and owners of the land are now aware that they have made a mistake in not providing for holding a portion of the water, and recognize the fact that the ditch is twice the dimensions it should have been. If it were not for the fall—4 ft. to the mile—a few locks or dams would hold the water when it will be needed for crops; but now it will take many.—*The Prairie Farmer.*

Albany, N. Y.—The plans for the driven-well plant on the Van Rensselaer flats have been radically changed within the past two months. As originally drawn the plans provided for one line of 21-in. pipe about a quarter of a mile in length, with two gang wells for each 14-ft. section of the pipe. To these gang wells other wells could be attached if necessary. With this single line of wells it was expected between 10,000,000 and 15,000,000 galls. of water daily could be secured. After testing the wells on the single line, Andrews Bros. decided to change the plan of the plant, with the hope of being able to furnish 20,000,000 galls. daily. Accordingly another line of 21-in. pipe, with gang wells attached, was placed 88 ft. west of the original line, thus making two 1,300 ft. parallel lines. The receiving tank was changed from the east to the west line, the size of the tank being enlarged from about 7 ft. by 7 ft. to 11 ft. by 11 ft. Supt. CORWIN states that between 300 and 350 driven wells will be required. The wells average between 35 and 50 ft. in depth. If an additional supply of water is desired more wells can be sunk and attached to the first plant. For every 14 ft. of piping in the present plant, there are two wells. An effort will be made to begin the test August 30.

THE Tenth Annual excursion and dinner of the employés of the National Meter Company of New York was held at Point View, July 28, and was pronounced the most enjoyable one of these gatherings ever held.

The excellent dinner was followed by several speeches, those by President JOHN C. KELLY and Secretary DAVID H. GILDERSLEEVE, who represented the Directors, being particularly appreciated.

RECORD OF NEW WATER-WORKS CONSTRUCTION.

(Specially Communicated.)

(CONTINUED FROM PAGE 78).

Worcester, N. Y.—The works were commenced Sept. 15, 1887, and completed Dec. 21, 1887. They were designed by GEO. N. COWAN, of Stamford, N. Y., who was also Constructing Engineer. The contract for the works complete was let to Francis Leonard, of Norwalk, Conn. The water supply is taken from Caryl lake to a reservoir with an area of 47 acres; the works are on the gravity system. There are 6 miles of pipe, 17 hydrants and 14 meters; the mains are of cast-iron and the services of lead. Ordinary pressure, 70 lbs; pressure regulators are used. Cost of works, $34,000; debt, $12,775; rate of interest, 6 per cent. Annual expense, $90. Annual revenue from consumers, $180; from city, $700. The franchise is for 99 years, and the city pays $700 per annum for 17 hydrants. The works are owned by the Worcester Water Co.; President, GEORGE HARDY; Vice-President, H. H. SMITH; Secretary, S. W. FERGUSON; Treasurer, M. H. NICHOLS. Capital stock, $25,000; (stock, $24,000; bonds, $10,000). J. T. HOEDSALL, is Superintendent. The present population is 1,400. The Ross pressure regulator is used, and there are two on the main line. The source is 519 ft. above the lowest point, and by an adjustment of the regulator the water can be increased or decreased. At present the pressure ranges from 50 to 90 lbs.; average, 70 lbs. (Date of special report, Feb. 10, 1888).

Huntington, Ind.—The works were built in 1887; and were designed and built by the American Water-Works & Guarantee Co., of Pittsburg, Pa., and this company now controls the works. The pumping machinery was furnished by H. R. Worthington, of New York; the pipe and specials by the Addyston Pipe & Steel Co., of Cincinnati, O.; and the valves and hydrants by the Ludlow Valve Mfg. Co., of Troy, N. Y. The supply is taken from the Ohio river and pumped direct by a pumping engine of 3,000,000 galls. daily capacity. There are 8½ miles of pipe, 84 hydrants and 326 taps; the mains are of cast-iron, and services of galvanized iron. Average daily consumption, 300,000 galls. Ordinary pressure, 40 lbs.; fire pressure, 90 lbs. Cost of works, $90,000; bonds, $75,000; rate of interest, 6 per cent. The franchise is for 30 years, and the hydrant rental is $35.71 per hydrant per annum. The works are owned by the Huntington Water Co.; President, W. S. KUHN; Secretary, J. MCINTYRE; stock, $100,000; bonds, $75,000. W. W. CUNNINGHAM is Superintendent. The present population is 8,000.

(TO BE CONTINUED).